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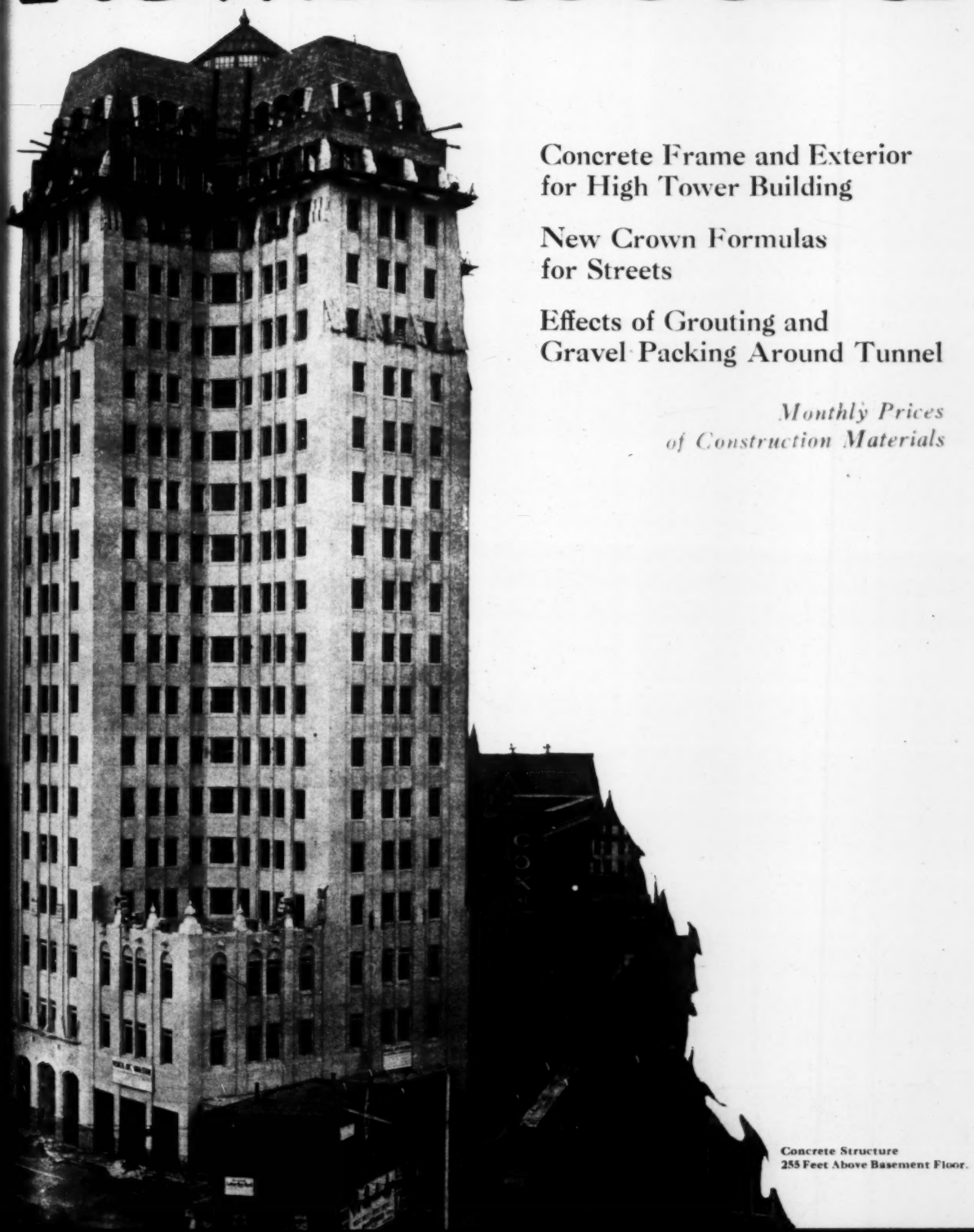
April 5, 1923

# Engineering News-Record



Concrete Frame and Exterior for High Tower Building

New Crown Formulas for Streets

Effects of Grouting and Gravel Packing Around Tunnel

*Monthly Prices of Construction Materials*

Concrete Structure
255 Feet Above Basement Floor.

This building is covered with Federal Red Interlocking Tile with glass inserts providing plenty of daylight. Note glass insert slab in center.

# The roof problem held the center of the stage—

THIS BUILDING—the big coliseum of the Michigan State Fair Association at Detroit—is practically all roof; so the foremost construction problem was a roofing problem.

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# FEDERAL Cement Tile

*"The Roof for Permanence"*

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# ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

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## Demolition Risks

TWO fatal building accidents were added to the record in the past week, one occurring during construction and one during demolition. The former is still wrapped in mystery, but it is evidently an accident of quite exceptional character, whose teachings are likely to be concerned with the details of construction. The other accident, however, has a more general aspect, particularly important because little recognized in the past. Demolition has a fairly bad record; it has produced many accidents, and while few of them have been serious they all combine to show that safety receives less consideration in demolition than in construction of buildings. There are two obvious reasons for this: the low grade of competence and craftmanship engaged in much of the work, and the fact that the work is done as cheaply as possible and without any specification control. But at the root of the matter lies a failure to recognize that public safety is involved in demolition just as much as in erection. It is true that demolition is simpler work and does not require the same technical ability as construction; but unless both skill and caution are applied it will be unsafe work, so that experienced supervision and inspection are essential. When these requirements are fully taken account of in building practice and regulation, demolition accidents will not give much further trouble.

## Enforcing a Code of Ethics

THANKS to an active publicity campaign the daily press is giving considerable space to the new code of ethics of the American Society of Mechanical Engineers. We read, for instance, that "the code is said to mark an advance in engineering ideals" and that "the society hopes it will ultimately apply to the entire engineering profession of the United States," just as though the mechanical engineers were here breaking new trails, leading a reluctant profession into the paths of righteousness. The facts are that the American Institute of Electrical Engineers has had a code of ethics since 1912, the American Society of Civil Engineers since 1914 and the mechanicals themselves a code, of which the current one is only a revision, since the latter year. What the mechanical engineers can do, and what their latest move promises that they will try to do, is to establish some active method of enforcing the code. In their new Committees on Professional Conduct, both the A. S. M. E. and the Am. Soc. C. E. have the making of a real ethical force which the engineering profession now lacks—bodies which not only interpret a code and thereby build up a common law of engineering conduct but which also take punitive action in specific cases. Engineering today has not the analogue of the lawyers' grievance committees, which on their own initiative or by complaint investigate individual lapses from the code and, if necessary, prosecute the guilty. There are just now one or two cases which cry out for some such procedure in the engineering profession, but they remain, as always, merely the subject of office and society gossip, with the dangerous and unfair connotations that gossip always involves. A code of ethics is only the first step toward professional integrity. Some way must be developed of enforcing the code.

## A Prospective Power Czar

IF GOVERNOR SMITH'S water-power bill just introduced into the New York State Senate becomes law, New York will have in its service the most powerful engineer in the world. This bill as written constitutes a new officer, a commissioner of hydro-electric power, who *ex officio* is the state engineer and surveyor. This officer can take over, control and utilize the waters of the Niagara and the St. Lawrence. He can transmit the power developed from these rivers anywhere in the state. He can contract with any municipality for the sale of such power. He can purchase, lease or otherwise acquire any privately owned land, easements, interests, riparian rights, structures, etc., which appear to him to be necessary for the development of power. He can condemn real estate. He can build anything necessary for the development or transmission of power. He can sell any power at any rate he chooses without interference from public service or utility commission. Finally, he can exercise such other and further powers and authority "as may be necessary or incidental to the carrying out and accomplishment of the provisions and purposes of" the above sentences. For the present this autocrat is only to have $1,000,000 at his command, but the prospective activities of his office would soon require many hundred times that amount. Such a proposed law by its very absurdity demonstrates some of the difficulties of putting into cold type the state control of water power.

## Crossing Rights

AN ECHO of old-time views—or perhaps it was more than an echo—made itself heard in a discussion of highway crossings at the recent meeting of the American Railway Engineering Association. The subject was a committee report dealing with revision of grades and alignment of highways at railway crossings, the alignment change being planned particularly to reduce the danger of accident. Several speakers in commenting upon the report took the attitude that the crossing should be made as difficult as possible for the road user, apparently on the ground that this would force him to be careful. It was urged that the road near the crossing should be laid out with sharp curves, and as much curvature as possible, so that road vehicles would have to slow down or stop. Whether this would conduce to safety is questionable. In fact one speaker at the meeting made the sensible remark that a crossing so built would cause the motorist to be more occupied with the difficulty of the curve and less with the possible approach of a train, so that safety would be reduced rather than increased. It is worth while re-

calling in the same connection the injunction given (by the railroad) at many crossing points, namely, to come to a full stop before crossing. Its intent is laudable, but its value is in doubt, at least when there is a curve in the railroad line and ample growth of brush at the crossing, as often happens. Similarly it is doubtful whether crossing safety is promoted by making the highway as troublesome as possible at the track intersection. Rough crossings, which compel a very abrupt checking of speed and often result in stalling, probably have more than one fatal accident to their credit. The road-crossing problem is not an easy one under the best of conditions, and it will continue to demand much study and conscientious planning. Its solution will not be promoted, however, by approaching it in the old-time spirit of antagonism between railway and highway interests. Railway men who approach the crossing problem in the antagonistic spirit of past days will probably find that they are working against the interests of the railway as much as against that of the highway. They hasten the day when universal abolition of grade crossings will be demanded.

### Concrete Rock Borers

LITTLE marine bugs with unnatural appetites for stone have been known for many years, but they have had more of a biological than an engineering significance. Because some of them have recently been active in Southern California waters and around the Caribbean is no reason for alarm, even though they seem to have transferred their taste from natural to artificial stone. This is well emphasized in the current letter of Mr. Squire of the California State Harbor Commission. There is no indication that such borers are a serious menace to concrete in sea water. Certainly, their activities should not be confused in importance with the less lively but much more widespread and dangerous activity of the sea water in which they live.

### Taking All the Credit

TOO frequently in engineering organizations is heard the complaint of the subordinate that the chief takes all the credit, to build up for himself a reputation which he can capitalize. For such self seeking engineers a paragraph in a recent letter from one of our most distinguished consulting engineers preaches a good sermon. "When I was starting professional work," he writes, "one of the older men who did a good deal to get me started in life told me that to succeed in professional relations it was necessary to let the other fellow have most of the credit. If a man could do the required work and get some fair share of the compensation that belonged to him, it was better to let the other fellow have some of the compensation and as much credit as he could get. Looking at it now, it is quite clear to me that my old friend was right. If a man gets too much credit for anything he does he is on the road to trouble." This is pragmatic and not ethical and should therefore appeal to the man who is in the habit of grabbing all the credit. His aim is to benefit himself and he is not to be influenced by considerations of what is right and proper. When, therefore, a successful engineer, who firmly believes in the essential rightness of a becoming modesty, testifies to the practical value of such modesty, his words take on a double significance. When a course is both right and profitable only a fool will not follow it.

## Closed Specifications for Highways

FAITH in competition and fear of trusts are combined in about equal parts in the legislative and executive activities which have made the past winter notorious in highway history. In New Jersey a law compelling open specifications has been enacted, and vetoed by the Governor and passed again over the veto, and the highway department has been given power to build a plant and manufacture cement for state works. In Ohio a committee of senators is investigating the charge that the materials interests are subverting highway management and the Governor is refusing compensation for old contracts and approval of new contracts where "one kind of material only is specified," and has sent official notice to the highway commissioner that "in every case where you ask for bids on brick, concrete or other high-priced construction, I demand that you also ask for bids on cheaper types, such as macadam or gravel." Other states exhibit a less pronounced mania, but in general, throughout the country it is open season for closed specifications.

The manifest absurdity of some of the action which has been taken does not relieve the situation from serious aspects. Any disposition evinced by legislators and heads of government to usurp the technical functions of their state engineering departments is dangerous. Such usurpation is exactly what the orders of the Governor of Ohio amount to. The absurdity of his "demand" indicates the lengths to which interference by those not trained in engineering may proceed. The development of a state highway system best adapted to the traffic requirements of all the people, with a provident eye to the future, is a complex engineering problem. If the engineers appointed are not capable of the task other more capable engineers may be secured. Only failure will follow any attempt of governor or legislature to substitute as technical experts.

So much for general administration policy. It is this policy that should dictate practice in respect to closed or open specifications. The closed specification is not inherently vicious. It is absolutely sound engineering in certain instances to call for a specific road material which may be patented or otherwise privately controlled. The practice becomes vicious only when the selection is influenced by dishonest motives or when the ignorance or prejudice of the engineer make him incapable of sound decision. It is true also that sales managers have not always hesitated to play on the ignorance or prejudice or honesty of the engineer. There has been misuse of the closed specification. Commonly, however, this has been by township and county road departments. Very few state highway departments, if any at all, can be justly accused of employing closed specifications commonly or even frequently.

Altogether the closed specification offers little danger to the public purse or to the quality of highways secured if it is employed by competent and honest engineers. It is wise to be suspicious of its use exclusively because competent and honest engineering never finds one kind or type of road always best. It is of very doubtful efficacy to legislate against it because no law can be drawn which gives the road purchaser adequate power of selection which cannot also be evaded if the agent of the public finds it to his interest. Any danger which the closed specification invites or the open specification can possibly repel is one which can be overcome by

responsible and honest engineering. In the end, whether specifications are open or closed, it is the engineer who picks the construction. The obvious duty of the legislature and governor is to pick good engineers and pay enough to get a good selection to pick from.

## Closing the Chicago River

TWO proposals to close the Chicago River are now being considered seriously by different official organizations. The first involves the age-old controversy of fixed versus movable bridges. The second is an ambitious program of roofing the entire river within the downtown district to make a low-level boulevard. The first is in the hands of a committee of the City Council and the second has been brought to the consideration of the City Plan Commission.

To an engineer new to the city's problems it would seem an enormous economic waste not to close the river. When this engineer has lived in Chicago long enough to hear of the long litigation over closing the Ogden ditch, so narrow a historic stream that not even a rowboat could navigate it, and the recent controversies with Congress over filling up Bubbly Creek, he realizes the undue power accruing to vested interests and riparian property holders. But if this new engineer investigates the steep descending grade of shipping in the Chicago River since the 80's and 90's he will find that ultimate abandonment of the river for shipping is plainly indicated. Perhaps if he is a taxpayer the large sums required for new movable bridges will further intrigue his investigative turn of mind. It will lead him to search for the reason why an insignificant little creek which at best is only an elongated slip should continue to be a restrictive thong around the neck of one of the greatest downtown business districts in the world. Plenty of arguments will be found on both sides, but those for the shipping interests have rapidly diminished while those arising out of congested traffic conditions and expanding business requirements are steadily on the increase. For years the business building area has been restricted by the river to the north and west and by the railroad terminals to the south. The railroad situation has been worked over so much that it now resolves itself largely into financial bargaining among the various lines. The river barrier has been accepted as fixed and only recently has a start been made to build a few business structures to the west and along Michigan Ave. to the north.

Undoubtedly the time has been ripe for several years for someone seriously to propose river elimination. Angus Hibbard, a local consulting engineer, has recently seized the opportunity, which has arisen because of the objections to the plan to eliminate the South Water St. produce market and make of it a double-deck thoroughfare, to propose a double-deck river roof. His plan is being widely discussed. About the same time the City Council committee proposed to find out why, under present conditions, fixed bridges cannot be built. Both proposals which lead to the same result so far as shipping is concerned, call for a careful consideration of statistics bearing on the case, and then a clear statement of the whole situation in a campaign of education to be placed before the business interests of the city. Eventually, river elimination or closure in Chicago—and, for that matter, in Milwaukee and in Cleveland—will come about.

## No Royal Road in Sewage Treatment

THE growing tendency to give sewage a preliminary treatment before sending it through an activated-sludge plant, and in general the adoption, sooner or later, of supplementary processes in the case of every method brought out as new, self contained and yielding an effluent of high degree, is freshly illustrated by the sewage-works of Graham, Texas.

In its simplest original form the activated-sludge process consisted of the accumulation and activation of sludge, sedimentation, decantation of the clarified liquor and, eventually, periodic removal of surplus sludge. Soon it was found that separate sedimentation tanks were advantageous. Leaving out of account here the sludge-dewatering problem and trials of paddles in place of air for agitation, it may be noted that besides the supplementary or separate sedimentation, various preliminary methods of treating the sewage before activation were used until now some one of them seems to have become common practice.

At the Graham sewage-works the designer has adopted grit chambers and the septic tank for preliminary treatment. His claims for results, given elsewhere in this issue, can better be judged after more extensive and varied experience. It seems obvious that if money is spent for septic or other preliminary treatment there should be less air or power required for activation and a less volume of final sludge, or if not these then some other compensating advantages.

As to the name adopted for the combination (patented) in use at Graham—"sept-aer-sed"—it should be noted that it seems better designed for promotion purposes than for technical nomenclature. Activated-sludge plants from the start have combined aeration and sedimentation, whether or not septic treatment has ever been used as preliminary to activation.

The most daring and perhaps novel feature of the Graham plant is night storage of the septic tank effluent, brought about automatically when the air blowers for activation are shut down. One would suppose that this would upset the functioning of the filtros plates and the whole activation process.

As suggested at the outset, however promising any new and at first blush self-contained process of sewage treatment may be, provided it is designed to yield a high-grade effluent on the one hand and on the other to solve the final sludge problem, time and experience generally lead to the adoption of supplementary treatment —preliminary, final or both. In extreme cases we may see a combination with more than three elements.

Fortunately, local conditions do not always demand the highest possible degree of sewage treatment. In such cases, the choice of a treatment process may be several elements of one of the several possible combinations for highest results, range from one such element to two or three or more. There is as yet no single straight royal road through the sewage disposal field. It is rather a choice between various roads, none royal, and all more or less bewildering on the one hand and on the other between various humble paths. In all cases a guide is required. The wise city will choose as a guide a competent disinterested engineer rather than a person or company devoted to some proprietary process of sewage treatment, held up to laymen city officials as the only solution for any and every local sewage problem.

# Concrete Frame and Exterior for High Tower Building

## Medical Arts Building at Dallas, Tex., 255 Ft. Above Basement Floor, Laid Out in Cruciform Plan With Beam and Girder Floors to Insure Rigidity

By W. J. Knight
Consulting Engineer, St. Louis, Mo.

EXTREME height and a cruciform floor plan mark the new Medical Arts Building at Dallas, Tex., as a novel type of reinforced-concrete structure, in which both height and plan developed some unique problems of design. The building is intended for the exclusive use of the medical and dental professions and occupies a prominent corner location in the center of the city. The first three floors occupy the entire irregular shaped lot but to increase air and light all floors above the third assume the shape of a cross, 111 ft. 6 in. x 111 ft. 6 in., with window openings along the three faces of each wing. Each wing of the cross is 39 ft. 6 in. wide by 36 ft. 4½ in., and has a total height of 255 ft. from basement floor to the top of reinforced-concrete roof. Office suites located in the four wings have direct access to a central lobby, octagonal in shape, and four high speed elevators. The first floor is to be occupied by stores devoted to the exclusive sale of articles, drugs, etc., common to the medical profession. An octagonal well opening is located in the center of the lobby for the purpose of furnishing additional ventilation for this portion of the building. All floors of all offices consist of cement finish properly hardened to resist wear and dusting. The corridors and lobbies are finished with terrazzo.

FIG. 1—THE MEDICAL ARTS BUILDING AT DALLAS, TEX., REINFORCED CONCRETE AND 255 FT. HIGH ABOVE BASEMENT FLOOR

The cost of a structural steel frame was also estimated for this building, but since the same amounted to about $75,000 in excess of reinforced concrete, the latter material was selected, not only for the frame but for the face.

Panels of all wings and center part of the building consist of reinforced-concrete ribs or joists 5 in. wide by 22 in. deep and 3 ft. 11 in. c. to c., extending in two directions. The top slab over joists is 2½ in. thick and reinforced with triangular mesh laid in two directions. Joists in elevation, Sec. A-A, Fig. 3, are reinforced with two 1-in. round rods, one straight with hooks at each end and the other bent up near the supports. Those in section in Sect. A-A are reinforced with two 1¼-in. rods anchored at each end. This type of floor construction was adopted primarily to give increased rigidity to the structure, in the event of high winds, besides permitting the same form units to be used for each consecutive floor. Each floor, in addition, is circumscribed by sprandrel beams of unusual depth and cross-section.

The typical floor panels are designed for the following superimposed and dead-loads: Cement finish 9 lb.; partitions, 20 lb.; ceiling and plaster, 10 lb.; live-load, 50 lb.; dead-load of floor, 82 lb.; total, 171 lb. per square foot dead- and live-load. The first floor, which consists of flat-slab construction, is designed for a live-load of 150 lb. per square foot, having for its supports additional intermediate auxiliary columns extending from basement to first floor level.

Each of the four elevator shafts are inclosed by 12-in. concrete walls extending from basement to twelfth floor and 8-in. thick walls above the twelfth floor level. These walls are reinforced as individual stayed column units, each about 15 x 12 in. with longitudinal ⅝-in. round rods from basement to sixth floor and ½-in. round longitudinals above the sixth floor. The column stays are ¼ in. round spaced 12 in. c. to c. (Fig. 3.) All walls of elevator shaft were designed and utilized as columns to support their respective loads from floors above, and also to serve as stiffeners to aid in counteracting the overturning action of high winds. The reinforcement of each wall unit in each story was assembled and wired together on the ground and later hoisted into place. The walls inclosing stairway and stack are reinforced-concrete faced with brick veneering.

All column foundations rest on hard solid rock, with an assumed maximum safe bearing value of 18 tons per square foot. All foundation piers are tapered on four sides from first floor level to 1 ft. below basement floor, such that the areas of bases are sufficient to

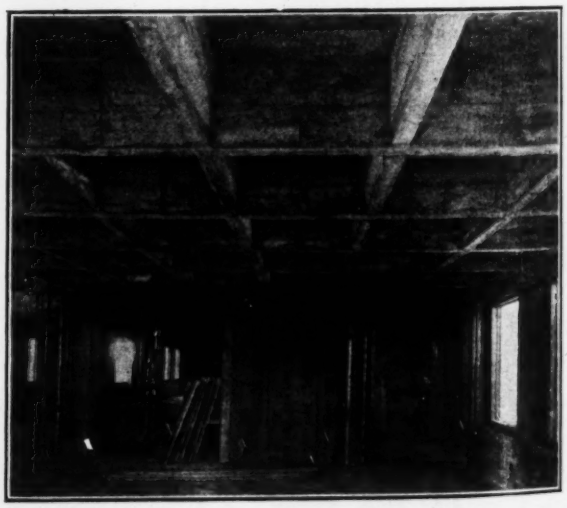


FIG. 2—INTERIOR OF FLOOR SHOWING FRAMING

satisfy the assumption of 18 tons per square foot or less as conditions required. (Fig. 4.)

At the fifteenth and sixteenth floors it was necessary to offset Columns 1 to 8 inclusive for architectural reasons. This presented rather an awkward situation in the absence of supporting girders, which were deemed objectionable. Fig. 5 shows the design of offset for Column 8 at the fifteenth floor and the construction employed to transfer the load through vertical shear in the fourteenth story column to the column in the story beneath. The column in the fourteenth story, 31x60 in., is designed with two spiral column units and banded together with ½-in. round ties 12 in. c. to c. The column in the thirteenth story is 33x33 in. and reinforced as indicated. Any tendency of eccentric load from column in fifteenth story to cause bending in column of fourteenth story is opposed laterally by the floor construction at the fourteenth and fifteenth floors and also by the resistance offered by the deep spandrel beams which converge at this point.

*Wind Stresses*—The structure is designed for a wind pressure of 20 lb. per square foot of wall surface, without considering any reduction in the unit stresses resulting therefrom in the concrete and steel. All results were obtained from calculations made according to the "cantilever method." The distance from floor to floor for all stories from the fourth to and including the eighteenth floor and attic is 11 ft. 6 in. Consider, for example, the fifth story of Columns 7 and 8. The horizontal wind load at each floor above and including the fifth is equal to $11.5 \times 17.33 \times 20 = 4{,}000$ lb. At attic the wind load is equal to $28.75 \times 17.33 \times 20 = 9{,}950$ lb. The total moment from wind is:

| | |
|---|---|
| $4{,}000 \times 971.75 =$ | 3,887,000 |
| $9{,}950 \times 155.25 =$ | 1,544,738 |
| Total moment, | 5,431,738 |

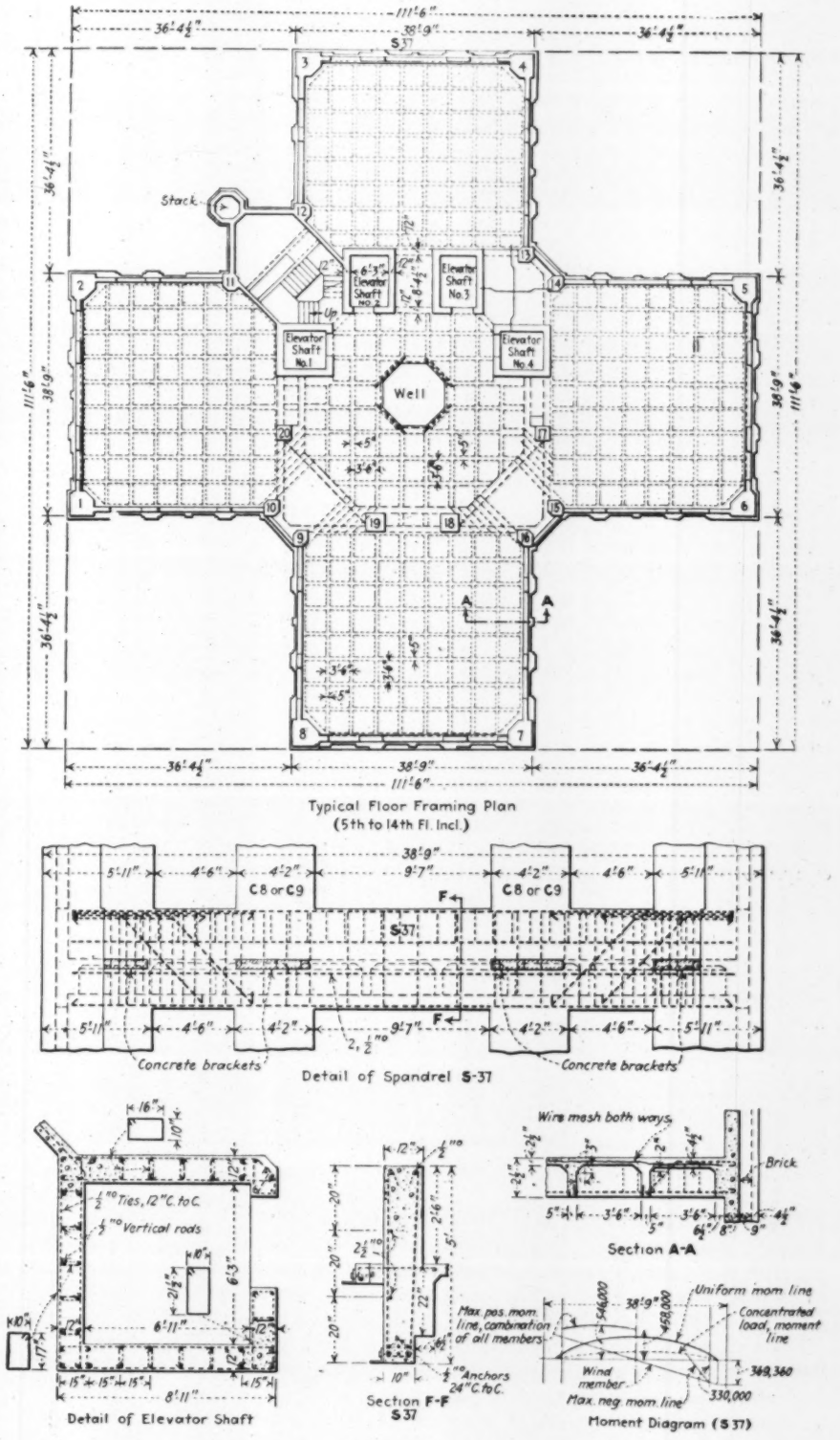



FIG. 3—TYPICAL FLOOR AND DETAILS OF BEAM FRAMING

Assuming 36 ft. as the average distance c. to c. of Columns 7 and 8 we have $(18X \times 18) + (18X \times 18) = 5{,}431{,}736$, or $648X = 5{,}431{,}736$; $X = 8{,}380$. The direct stress in fifth story column is equal to $18X = 18 \times 8{,}380 = 150{,}840$ lb. The total horizontal shear in fifth story for the two columns is the sum of the

wind loads above, or 62,000 lb. The total horizontal shear in fourth story is 66,000 lb. (Fig. 7.)

Referring to Fig. 7:

$M_0 = 20{,}520 \times 18 = 369{,}360$ ft.lb.

$M_1 = 33{,}000 \times 3.25 = 107{,}250$ ft.lb.

The thrust $= 4{,}000/2 = 2{,}000$ lb.

Spandrel beams *S*37 (see details Fig. 3) are 12x60 in. The combined moments from wind, floor and masonry loads were computed. These beams are designed for a maximum positive moment of 546,000 ft.lb. or 6,552,000 in.lb. and a maximum negative moment at the face of each support due to wind, of 330,000 ft.lb. or 3,960,000 in.lb. Two intermediate concrete struts, 12 in. x 3 ft. 10¾ in., extending from fourth floor level to attic floor, were designed to furnish sufficient lateral stiffness for the rectangular compression flanges of all inverted spandrels.

All rods of beams and panels at free bearing ends were hooked regardless of whether the theoretical calculations required anchorage, in order to insure a rigid frame.

The mansard roof construction is rather involved due especially to the necessity of suspending from the ends of reinforced-concrete cantilever beams, the loads from two house tanks located in the pent house story beneath the roof, and weighing 40,000 lb. each. (Fig. 6.)

The assumed principle of continuity and the effective rigidity of joints as applied to the design of reinforced-concrete frames of the roof, gave results somewhat in excess of calculations made in true accordance with the theory of rigid frame construction. Before the design of the roof frames was undertaken a close investigation was made of the tests performed by the University of Illinois, in 1918, of rigidly connected reinforced-concrete frames. The results of these tests were somewhat inconsistent with theoretical computations. The discrepancies ran up to 50 per cent and in some instances even greater. The area of roof being comparatively small, it was determined to make calculations on a more logical, practical and conservative basis, and then to check the results by utilizing theories applicable to this particular form of construction.

Viewed in the light of professional differences of opinion, which have created ominous forebodings in the mind of the average layman and others who are not versed in the art of design, it would appear that reinforced-concrete buildings should be limited within certain heights, implying that height and not unit stresses in the materials, is the dominant factor that should control whether the design is safe and in accordance with good practice. The term "good practice," as relates to reinforced-concrete design, is being frequently disturbed

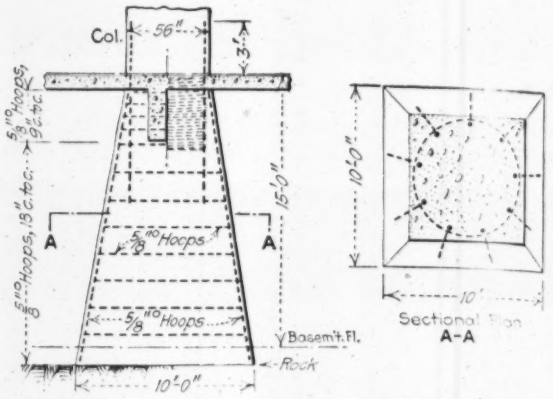



FIG. 4—FOUNDATION PIER SHOWING BATTERED DESIGN

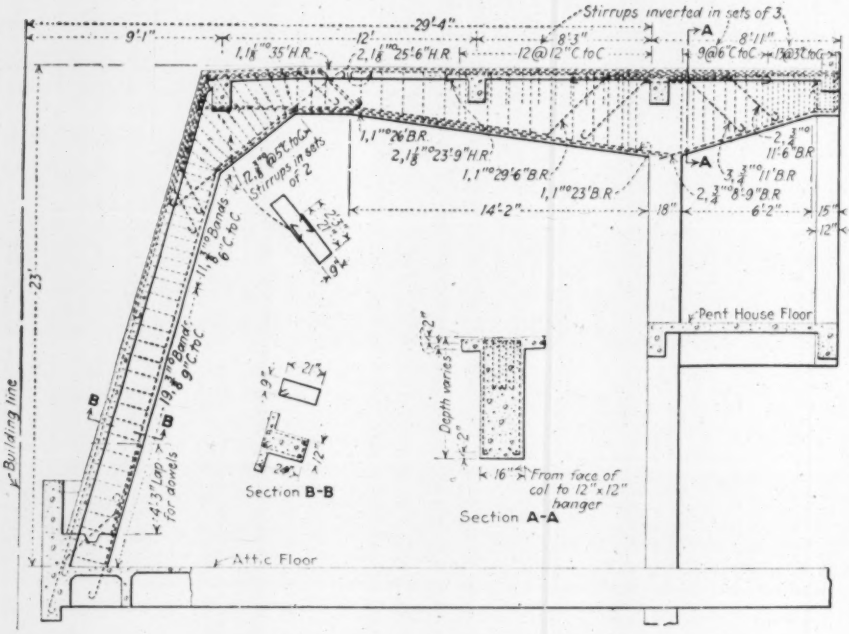



FIG. 6—DETAILS OF FRAME AT MANSARD ROOF

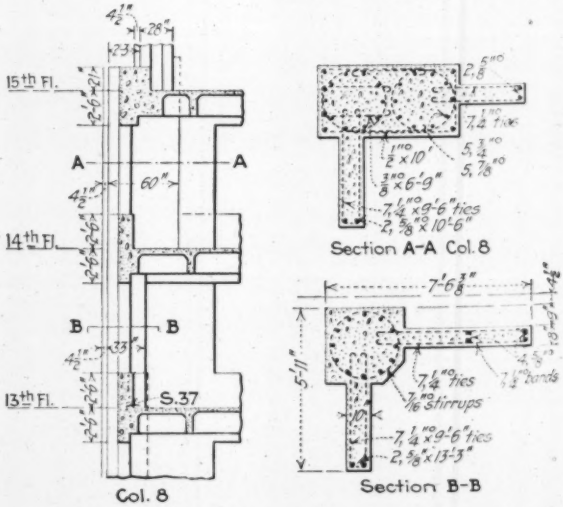



FIG. 5—OFFSET COLUMN AT FIFTEENTH FLOOR

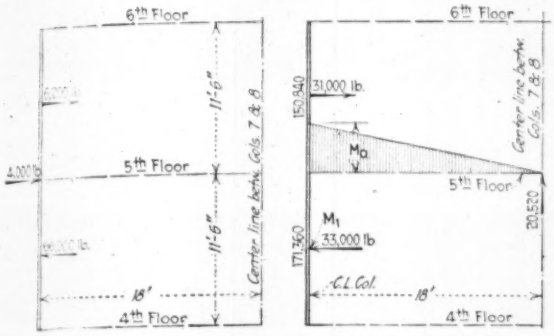



FIG. 7—METHOD OF FIGURING WIND STRESSES
See also wind stress diagram for spandrel beam on Fig. 3.

from time to time, by many engineers who are unwilling to accept conclusions based only on arbitrary selection, or from the mere fact that precedents fail to exist. Justification for a subsequent design may not always be exemplified by past experience.

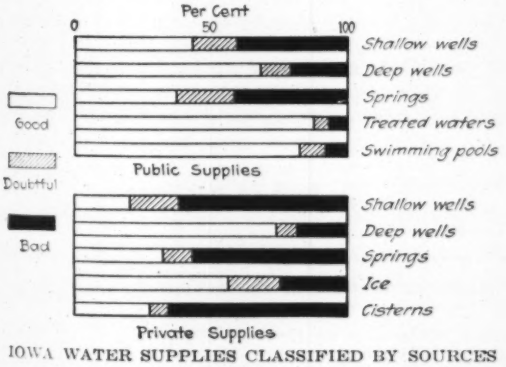
The height of any reinforced-concrete building depends entirely upon the limitating size permissible for the columns and the permissible proportion of members that furnish resistance to stresses induced by high winds and normal loads in combination.

Due to the position of the largest columns in the finished structure the unusual column sizes did not present a condition that was considered objectionable. Referring to Fig. 2, showing typical floor framing plan, Columns 1 to 8 inclusive are 56 x 56 in. in the first story and reinforced with twenty-five 1¼-in. round longitudinal rods and ⅝-in. round spirals having a pitch of 2 in. These columns, in the first story, are designed to support 2,580,000 lb., of which 180,000 is due to wind.

The structural design of the building was made by W. J. Knight, consulting engineer, St. Louis, Mo., M. F. Marks, principal assistant. C. E. Barglebaugh of Dallas, Texas, was architect and George W. Hewitt, of Dallas, was the general contractor. Cary-Schneider Investment Co. are the owners and S. W. Straus & Co. of New York and Chicago are underwriters.

## Public and Private Water Supplies Compared

Comparison of public water supplies with private supplies in Iowa made by J. J. Hinman, Jr., at a recent meeting in Iowa Engineering Society indicated that the




IOWA WATER SUPPLIES CLASSIFIED BY SOURCES

public supplies are the more sanitary. The diagram shows conditions as classified by analyses made in the Board of Health laboratory in the period from July 1, 1915 to July 1, 1922.

## Moisture-Resistant Coatings for Wood

SHRINKING and swelling and internal stresses causing warping and checking are brought about in wood by changes in the moisture content. Such changes are occurring continually when wood is exposed to changing atmospheric conditions, and the only way to prevent or retard them is to protect the wood from the air with some moisture-resistant finish or coating. In order to determine the protection against moisture afforded by various coatings, a series of tests is being conducted by the U. S. Forest Service, at the Forest Products Laboratory, Madison, Wis.

Linseed oil, although it is probably recommended more frequently than most of the other materials for moisture-proofing wood, was found in the absorption tests to be quite ineffective. Five coats of hot oil followed by two coats of floor wax failed to give any great protection.

Oil paints form a film over wood which is very durable even in exterior locations. Laboratory tests show, however, that such a film, although it may be continuous, does not prevent moisture changes in wood. Graphite paints and spar varnish are about as effective as the ordinary oil paints with the heavier pigments.

Cellulose lacquers rank somewhat higher than the foregoing in moisture-resistance. Considerable improvement can probably be effected in them by the addition of solids. They have the advantages that they are fast drying and that the films they form over the wood are very elastic.

Rubbing varnishes afford considerably more protection against moisture than do spar or long oil varnishes. The larger amounts of gum solids present in rubbing varnish probably account for their greater moisture resistance.

Enamel coatings made by the addition of pigments, such as barytes, to ordinary varnish are about as effective as rubbing varnish.

A bronze coating composed of a cheap gloss oil and aluminum powder proved in tests to be superior in moisture-resistance to any of the coatings mentioned above. This mixture is very fast drying; three coats can be applied in the course of half an hour.

The aluminum-leaf coating developed at the Forest Products Laboratory particularly for the protection of airplane propellers, is highly efficient in preventing moisture changes in wood.

Some asphalt and pitch paints are highly moisture-resistant. They are rather cheap and may be applied almost any place where their color is not objectionable. Attempts to discover a means of covering asphalt and pitch paints with lighter-colored materials have met with little success.

For temporary protection against moisture changes, vaseline smeared over varnish is one of the most moisture-resistant coatings yet tested. Another temporary protection, a heavy coat of paraffine, is about as effective as rubbing varnish.

The following table gives the results of moisture absorption tests on panels coated with the different preparations. The percentages are based on average amounts of moisture absorbed per unit surface area by coated and uncoated panels subject to a humidity of 95-100 per cent for 14 days.

| TREATMENT | Percentage Efficiency |
|---|---|
| Aluminum-leaf process—asphalt paint base | 98 |
| Three coats spar varnish coated with vaseline | 98 |
| Three coats of asphalt paint | 96 |
| Aluminum-leaf process—spar varnish base | 95 |
| Aluminum-leaf process—cellulose lacquer base | 94 |
| Aluminum-leaf process—oil paint base | 93 |
| Three coats of aluminum bronze (quick drying) | 92 |
| A heavy coating of paraffine | 91 |
| Three coats of rubbing varnish | 89 |
| Three coats of enamel | 88 |
| Three coats of orange shellac | 87 |
| Three coats of cellulose lacquer | 73 |
| Sheet pyralin 5/1000 in. thick glued to wood | 68 |
| Three coats of graphite paint | 61 |
| Three coats of spar varnish | 60 |
| Three coats of white lead oil | 54 |
| Five coats of linseed oil applied hot and two coats of wax | 38 |
| No coating | 00 |

# Flood Conditions and Land Filling at Cairo, Ill.

## Proposed Raising Grade of Low Areas—Sand Boils in Leveed Area Caused by Underground Sources and Not by Rivers

THAT sand-boils and seep water inside the area protected by levees at Cairo, Ill., are fed by ground water and not by the adjacent rivers is an important conclusion presented in a recent report on flood protection for the city and an adjacent drainage district. A second important feature is that the report recommends raising the grade of all low areas of the city within the levees by means of a municipally operated suction dredging plant.

Owing to public apprehension during the long duration of the 1922 flood a special improvement commission was appointed by the city in co-operation with several civic organizations. This commission engaged the engineering firm of C. E. Smith & Co., St. Louis, Mo., to report on flood and drainage conditions in the city and in the drainage district. The investigation was made by W. C. Curd, consulting engineer, Chicago, who was at that time Chicago manager of the company. A brief abstract of his detailed report follows.

*Flood Conditions*—A difficult problem in flood protection by levees and pumping plants has been faced by the city of Cairo for many years, as the city is situated on a low and flat peninsula at the confluence of the Ohio and Mississippi rivers. Both of these streams are subject to periodical heavy floods, but fortunately the excessive stages in the two rivers do not occur at the same time. Porous sandy soil affords a poor foundation for the protective levees. The population of the city in 1920 was about 15,200.

From a 60-year record it appears that the greater number of floods has come from the Ohio, owing largely to climatic conditions. Of 53 floods since 1869, 22 occurred in April, 14 in March, and 8 in February, or 41.5, 26.4 and 15 per cent of the total. The Ohio drainage area of 203,900 square miles has an annual rainfall of 40 to 45 in., of which approximately 32 per cent is runoff. In the upper Mississippi valley, with 172,000 square miles of drainage area, the rainfall is 34 in. and the runoff 27 per cent, while in the Missouri drainage area of 527,000 square miles the rainfall is only 20 in. and the runoff only 12 per cent. In the Ohio valley the heaviest rainfall occurs during January, February and March, but in the Missouri and upper Mississippi valleys it is in May and June. Since the Ohio drainage area is the most southerly, it receives the effect of the storms from the Gulf while the other two drainage areas are still icebound.

Floods from all streams tributary to the Ohio and the Mississippi have never fully combined at Cairo and such an occurrence is a remote probability, according to the report. But should they combine, "a flood of twice the volume of any that has so far occurred may be expected." In some instances a great flood in one river has combined with an average stage in the other and this combination has produced record stages at Cairo, but as a rule the combined flood runout of the Ohio, Cumberland and Tennessee rivers comes first, then that of the upper Mississippi and lower Missouri, and finally that of the upper Missouri.

Levee work on the Mississippi below the mouth of the Ohio has increased flood heights and appears to have raised the stage of the 1922 flood at Cairo 2½ to 3 ft. above what it would have been with the natural bank overflows of ten years ago. But the city levees, with a crown elevation of 60 ft. on the Cairo gage, have still a freeboard of 5 ft. above the maximum stage of April 4, 1913. This stage was 54.8; next to this was 54 ft. on April 6, 1912, and 53.6 ft. on March 26, 1922. Beginning with 1862, there have been fifteen floods above the 50-ft. stage.

*Cairo Levees*—Since the first levee was built in 1828 there has been a gradual but intermittent growth in size and extent of the levees, marked in earlier days by occasional destruction resulting in disastrous flooding. At the present time a total of about $2,500,000 has been spent on the levees by the city, the drainage district and the U. S. Government, with the result, according to the report, that the people should now have "abundant faith in the security given their homes and property." A continuous levee system of about twenty miles surrounds Cairo and the Cairo drainage district and the enclosed area is divided by a cross levee near the north city limits. In case of a levee break in either section the other section can be shut off by flood gates in the cross levee. All the levees are reported to be in good condition.

Most of the levees are occupied by railway tracks, which is considered a favorable condition on account of the greater crown width and cross-section, the compacting of the material by traffic and the better maintenance by railway forces. In ordinary cases the larger cross-section required for railway use would cover the line of saturation, so that the usual banquette for high river levees could be omitted.

But at Cairo this saturation line is raised where seep water stands against the inner side of the levee and the base thus becomes saturated from both sides. As a result some sloughing of inside slopes has occurred and more may be expected unless the seepage is kept away from the levees either by pumping or by filling the land to a height sufficient to serve as a banquette. The report recommends the latter method as affording additional stability and safety and also reducing the objectionable standing water inside the protected area.

Three slides in the Ohio levee occurred in 1915, but were repaired by means of steel and wood sheeting and rock-filled cribs. The report states that undoubtedly these were caused by ground-water breaking through to the river after the flood of that year had receded. It is considered that the bank at each of these slides has fully settled and that no further trouble will occur. Caving of the right bank along the Ohio is occurring above the Illinois Central R.R. bridge, the current being thrown against this bank by a deflection dike built on the Kentucky side opposite Mound City, Ill., by the U. S. Government. Some revetment has been placed but the report advises the city to petition for further protection on account of the menace to the levees.

*Sand Boils due to Ground Water*—Both sand boils and seep water are experienced at Cairo during floods and cause considerable alarm. Along the lower Mississippi River it is the general belief that sand boils are formed by river water working through small channels under the levees. But the report states positively that sand boils at Cairo are fed by ground-water in the

underlying sand and gravel formation and not from the river. This formation is about 375 ft. in thickness and is underlaid by rock. In regard to this question the report is quoted as follows:

Seep water is underground water which, under pressure, works its way to the surface and spreads out over the low areas. Sand boils are small springs bubbling vertically out of the ground, the water being under sufficient hydrostatic pressure and velocity as to carry in suspension silt and sand from underlying strata which, on reaching the surface, settles out and builds up around the rim of the boil in the form of a frustum of a cone. Sand boils and seep water in Cairo are of the same origin, the one being a gradual increase in elevation of ground-water over a large area, whereas the other is a rise concentrated at some point of weakness in the formation where insufficient resistance is offered to prevent a rapid flow of ground-water to the surface.

The popular belief throughout the Mississippi Valley is that sand boils and seep water are fed by the river, through small channels in or under the levee. It can be stated positively and authoritatively that the sand boils and seep water in Cairo are not in any manner connected with the rivers, but accompany floods only as a result of high pressure upon the underground flow. Cases are known where underground connections or channels have been developed between rivers and leveed areas, but such cases should more properly be classed as "blow outs" rather than sand boils, for they generally appear in locations where logs, stumps or roots in process of decay have not been removed in constructing the levee.

The mineral content of water affords one of the most positive proofs of its source. In the analyses given in the accompanying table, it will be noted that there is no similarity between the water in the rivers and that from sand boils, the Bucher well or the seepage. These latter are all ground water. The Ohio water contains 8.98 grains of mineral salts per gallon, the Mississippi 12.46 grains, while the sand boils, seep water and well water vary from 28 to 42 grains, or three to four times that found in the river water.

MINERAL ANALYSES OF WATERS AT CAIRO, ILL.

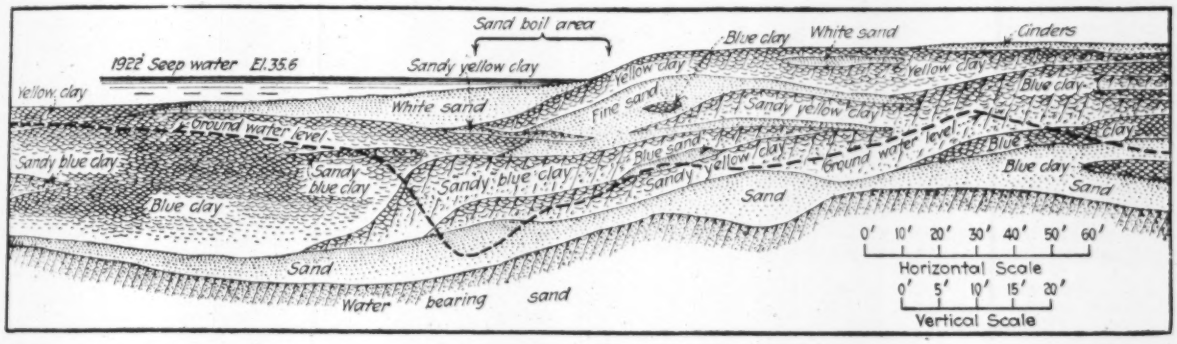
| Mineral Salts | Rivers | | Sand Boils | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Ohio | Miss. | Well at Bucher Plant, 65 ft Deep | Seep Water From 10th St. Pump | At Bucher Plant | At 40th and Commercial Sts. | At 40th and Commercial Sts. | At 32nd and Poplar Sts. |
| Cal. Carb. | 5.040 | 6.160 | 19.100 | 21.350 | 20.600 | 18.580 | 20.050 | 25.600 |
| Sod. Carb. | ..... | ..... | 1.840 | ..... | 0.036 | ..... | ..... | ..... |
| Mag. Carb. | 0.478 | 1.100 | 6.080 | 1.420 | 7.350 | 5.020 | 5.760 | 2.380 |
| Mag. Sul. | 1.127 | 1.043 | ..... | 6.250 | ..... | 1.111 | 1.284 | 6.000 |
| Sod. Sul. | 1.248 | 3.070 | 0.746 | 4.240 | 1.080 | 2.306 | 4.450 | 6.260 |
| Sod. Chl. | 0.674 | 0.768 | 0.672 | 8.640 | 1.350 | 1.155 | 1.350 | 6.695 |
| Sod. Nit. | 0.422 | 0.422 | 0.139 | 0.099 | 0.072 | 0.054 | 0.139 | 0.100 |

Note: Samples of water were taken from sand boils while flowing and from seepage areas, wells and the rivers. These samples were sent to the Illinois State Water Survey for analysis.

It will also be noted that the ground-water runs high in carbonates of calcium and magnesium. These salts come from limestone and are, unquestionably, taken into solution by rain water as it percolates from the ground surface downward through the limestone bluffs which line the Mississippi and Ohio valleys above Cairo. The mineral content must be in water before it reaches the sand and gravel under Cairo. There is nothing in that formation, in the way of mineral salts, that is soluble in water.

Borings made to determine why the sand boils were prevalent in certain areas indicated that the reason was a weakness in the surface formation, the ground-water under pressure passing up readily through the sand wherever the covering is thin. In the typical section given herewith the dotted line represents the ground water level at the time the borings were made. In each location bored this level is fairly uniform on either side of the boil but at the boil it drops down sharply into the water-bearing sand.

This condition indicates the influence of capillarity upon the height of water in a tight clay, but in the greater porosity of the sand formation at the boil, capillarity has little effect and the water is found at its true static level. At flood time, when the ground-water is under pressure, less resistance is offered in the sandy soil and the water rises quickly to the surface.




SECTION OF STRATA AT SAND BOIL

In this cross-section there will also be found an explanation of why the ground settles down at some boils and why it does not at others. It depends entirely upon the formation and whether there is sufficient velocity in the water through the boil to scour out enough material, at one point, to create a cavity that will break down. This is the disquieting fact about sand boils, for it can never be foretold what the formation is in that vicinity or what the velocity of the boil will be.

*Sewers and Drainage Pumps*—The city has an extensive sewerage system, but it appears that the seep water situation has imposed a condition on the sewers for which they were not designed. Radical changes are recommended including the division of the city into several sewer districts, each to have its own main sewer with a pumping station at the mouth. In this way the flow height of each district could be regulated in flood time to meet any conditions of storm water or seep water.

Four electrically operated pumping stations are maintained in Cairo to handle drainage and sewage at flood time, but a resetting of the pumps to give better head conditions is recommended as a means of securing less power consumption and greater pumping capacity. It is stated that in this way the present aggregate pumping capacity of 45,700 gal. per minute at minimum head and 38,500 at maximum head could be increased to 68,500 and 49,500 gals. respectively. It is also recom-

mended that the pumps should be so operated that the sewers will not be under pressure but will flow not more than half full during storms. At present the low areas throughout the city are said to afford sufficient reservoir capacity when full to flood the entire city to a depth of nine inches. As these areas are filled or otherwise eliminated additional pumping facilities will be required, which facilities would be located with reference to the new sewers recommended.

*Filling the Leveed Areas*—Not only is filling recommended along the levees, to protect their bases from seep water, as noted above, but the report advocates filling all the low areas within the city to an elevation of 1 to 3 ft. above the present street grades as a means of preventing sand boils and seep water. The greater depth of fill would be to provide sufficient cover at sand boil areas or additional stability to the inner slopes of levees. The fills would be from 1 to 7 ft. deep in general, but would have depths of 12 to 17 ft in a few places. This filling would aggregate about 3,150,000 cu.yd. in the city and 1,250,750 cu.yd. in the drainage district, or a total of 4,400,750 cu.yd.

Suction-dredging is considered the only economical method of placing the material and for this work the fine sand of the Ohio, with variable percentages of silt and clay, is preferable to the coarse sand of the Mississippi. At certain points, however, the distance from the Ohio is too great and the dredge would have to work in the Mississippi. It is estimated that the discharge would have 12½ to 15 per cent of solids.

An interesting detail is a proposition to carry the discharge pipe along the Ohio River bridge, since the dredge would work over a bar on the Kentucky side, so that navigation would interfere with a floating line of pontoons. From the dredge there would be 1,000 ft. of floating line extending to the 16-in. riser of an 18-in. line about 3,300 ft. long, suspended from the bridge. The Cairo end of this pipe would be about 60 ft. above the general ground surface, thus affording gravity flow to long distances before a relay or booster pump would be required to reach remote areas.

A municipal electrically-operated dredging plant for the filling program is recommended, with a capacity of about 1,000,000 cu.yd. per year. Its operating cost is estimated at 7 to 8c. per cubic yard of material delivered, while interest, depreciation and other overhead expenses would make a total cost of about 12c. per yard. It is predicted that when the work is under way public opinion will favor a continuance of the filling beyond the quantity estimated and that when the work is finished it will not be difficult to sell the plant at a good price for similar work at other communities.

Under the plan proposed the city would purchase the plant by a bond issue and would take care of maintenance and overhead expenses by general taxation. The operating cost of 8c. per yard could be charged directly against the property filled and would amount to about $1.50 per front foot for a 5-ft. fill on an ordinary city lot. It is suggested also that the dredge, with its own generating plant on board, could furnish excess current for municipal uses and that during flood stages, when dredging must be stopped, current could be supplied to operate the drainage pumps which handle sewage and seep water. Furthermore, by this filling program, much of the low area which is now useless would be converted into good sites for factories and other industrial development.

## England's Four Railway Systems

SINCE all the numerous large and small railways of England and Scotland (with a few exceptions not yet disposed of) are now amalgamated to form four great systems it is of interest to record particulars of the mileage, equipment and business of these systems. Their general geographical arrangement is shown in the accompanying cut, but they overlap and interlock to a considerable extent, so that there are still many competitive routes. The names of the new systems are as follows: London, Midland & Scottish Ry.; London & Northeastern Ry.; Great Western Ry.; Southern Ry. From statistics given in the *Railway Gazette*, London, the accompanying table has been prepared. Traffic and financial figures given in this table are the totals for 1921 for the several railways now combined in each of the new systems. The steamers listed are mainly for the cross-channel service maintaining direct communication with Ireland, France, Belgium and Holland.

GROUPING OF BRITISH RAILWAYS

Territories occupied are as follows: A, London & Northeastern Ry.; B, London, Midland & Scottish Ry.; C, Great Western Ry.; D, Southern Ry.

STATISTICS OF ENGLAND'S NEW RAILWAY SYSTEMS

| | L., M. & S. Ry. | L. & N. E. Ry. | Gt. West Ry. | Southern Ry. |
|---|---|---|---|---|
| Area indicated by letter on map | B | A | C | D |
| Miles of line | 7,790 | 6,500 | 3,800 | 2,200 |
| Miles of track including sidings | 20,100 | 17,500 | 8,750 | 5,400 |
| Locomotives | 10,400 | 7,700 | 4,050 | 2,390 |
| Passenger cars | 27,000 | 20,000 | 10,100 | 10,800 |
| Freight cars | 315,000 | 297,000 | 90,000 | 37,500 |
| Company cars | 22,300 | 16,500 | 9,700 | 2,280 |
| Electric motor and trail cars and electric locomotives | 551 | 153 | 60 | 460 |
| Rail motor cars | 32 | 10 | 70 | 14 |
| Steamships | 72 | 22 | 16 | 38 |
| Motor vehicles; passenger | 12 | 70 | 70 | 9 |
| Motor vehicles; freight and parcels | 1,130 | 140 | 270 | 115 |
| Canals, miles | 350 | 295 | 213 | 4 |
| Passengers carried | 338,687,000 | 232,000,000 | 112,321,000 | 171,470,000 |
| Freight, tons | 19,300,000 | 19,000,000 | 8,000,000 | 4,000,000 |
| Coal and minerals, tons | 63,150,000 | 65,000,000 | 32,600,000 | 3,050,000 |
| Cattle, head | 6,937,000 | 6,200,000 | 2,300,000 | 1,100,000 |
| Trainmiles, passenger | 61,000,000 | 46,000,000 | 28,000,000 | 31,000,000 |
| Trainmiles, freight | 41,800,000 | 32,000,000 | 17,200,000 | 5,800,000 |
| Trainmiles, electric | 3,831,000 | 730,000 | 330,000 | 4,711,000 |
| Trainmiles, rail motor | 384,500 | ..... | 611,000 | ..... |
| Engine miles, steam including switching | 178,380,000 | 132,000,000 | 74,500,000 | 54,000,000 |
| Gross receipts | $553,750,000 | $450,000,000 | $227,500,000 | $165,000,000 |
| Total operating expenditure | $473,000,000 | $392,500,000 | $192,500,000 | $142,500,000 |

## How to Get Better Engineering Contracts

To bring home to the individual engineer the necessity of the practical application of the principles of ethics in all of his relations with the public and with his fellow engineers, a committee of the Minnesota Surveyors and Engineers Society recommends a wider circulation of codes of ethics, and more particularly the approval or disapproval of forms of contracts for engineering services by engineering societies.

# Effects of Grouting and Gravel Packing Around Tunnel

## Excavation Over Tunnel Shows Grout Flow Through Fissures — Gravel Shooting Effective in Preventing Settlement

By W. E. Thompson
Assistant Engineer, New York Transit Commission, New York City

THE recent removal of the material over and between a pair of cast-iron lined tunnels of the New York rapid transit subway for a length of approximately 350 ft. under Willoughby St., Brooklyn, in connection with the building of a station at Lawrence and Willoughby Sts. offered an opportunity to observe the results obtained by the separate injection of screened gravel packing and cement grout through the grout holes in the cast-iron lining at the time the tunnels were driven a few years ago. The excavation uncovered also a timbered drift, 60 ft. long, which had been driven between the tubes shortly after they were constructed, and disclosed the effect upon the surrounding soil of the grout injected through the poling boards of the roof. Fig. 1 shows a typical section through the excavation. The results noted are of particular interest as showing the extent to which the group penetrated and filled cracks and voids in the overlying material, at the same time failing to disclose a single instance of its having penetrated the interstices between the particles of bank sand. The action of the gravel packing is interesting, because it was in connection with the construction of the rapid transit subway tunnels that this material was used for the first time as a filling for the cavity left by the passage of a shield.

The Willoughby St. tubes were driven in 1915 and 1916, and the small timbered drift was excavated in 1918. The tubes connect with the Montague St.-Whitehall St.-East River Tunnel, now under operation by the N. Y. Consolidated R.R. (B. R. T.), and are of similar construction. The material through which they passed, where the recent excavation for the station was made, consisted of loose sand and gravel mixed with cobblestones. This was overlaid by a stratum of stiff sand and clay, containing many boulders, which extended from a few feet above the tops of the tubes to the surface of the ground. Numerous subsurface structures also were present in the street over the tunnels as shown in Fig. 1.

As the route of the railroad extended through narrow streets, lined with buildings and containing many subsurface structures in the form of water and gas mains, sewers and electric ducts, it was evident that the prevention of settlement necessarily must be a very important part of the work. In order to accomplish this purpose the contract, in addition to requiring the use of great care in driving the tunnels, provided for the injection of cement grout through the segments of the cast-iron lining for the purpose of filling all voids outside the tubes. This method was in accord with the best previous practice, but it has these disadvantages; it is difficult to confine the grout and prevent its return into the tail of the shield and it requires time for the grout to set before becoming effective, thereby causing delays which result in slow tunneling progress. To overcome these disadvantages, the contractors introduced the use of screened gravel as a filling for the annular cavity left by the passage of the shield, supplementing this by injecting grout as provided in the contract. The injection of gravel filling possessed the advantages that the gravel could be injected during the shove immediately behind the shield, and it became effective at once to support the surrounding material, thereby promoting rapid tunneling progress. It was found also that the grout would not readily penetrate through the gravel and leak into the tail of the shield, and it was possible, therefore, to keep the grout closer to the shield than could otherwise have been done.

The gravel was of such size that it all passed a ½-in. screen. It contained 33 per cent voids when packed, and was injected by means of an air blast at a pressure of 80 to 90 lb. per square inch. The gravel was fed into the discharge lines from two tanks mounted on a moving platform behind the shield and, to facilitate its

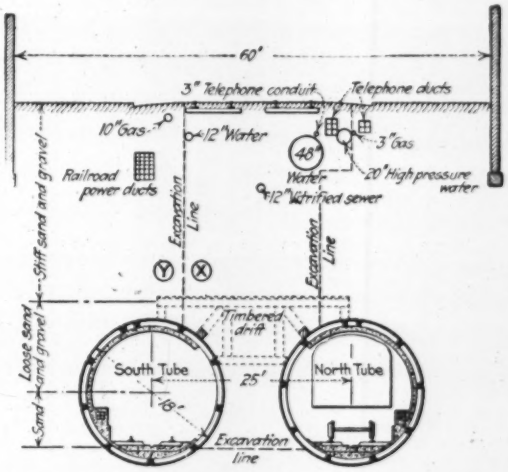



FIG. 1—CROSS-SECTION OF TUBES LOOKING WEST
Grout was found in pockets underneath the 48-in. water main to which it penetrated through fissures in the ground lying above the tunnels. Figs. 3 and 4 show the conditions at points marked Y and X respectively.

passage through the discharge lines, the tanks were filled with water to the level of the top of the gravel. In the Willoughby St. tunnels, the best results were obtained by injecting gravel through the top segments while the shield was being shoved ahead, for the erection of the next ring, the length of the shove being 2 ft. 2 in. Before starting each shove the pipes and valves were set in place in the upper grout holes of the ring that was about to pass out of the tail of the shield, and connection was made to each of the pipes in turn. As many successive connections were made with each pipe as were possible, the gravel being injected to refusal each time. The time consumed by each shove was usually about fifteen minutes, and upon its completion, gravel was injected through the plates below the spring line, beginning at the lowest plate. On the approach sections of the river tunnels where the work was done under compressed air, it was the practice to inject the gravel first through the bottom plates, working up to the top of the tunnel as the shield advanced.

Grout, consisting of one part sand and one part natural cement, about the consistency of cream, was injected through the grout holes beginning at the bottom segment of each ring, then making a connection to each segment, moving upward to the top of the tunnel. The grout was injected at a pressure of 90 lb. per square

inch, usually through the tenth ring back of the shield. Before grouting, it was necessary to open a passage for the grout by forcing a rod out through the gravel which lay over the grout hole, as it was found that in general the grout would not penetrate through the gravel. The arrangement of grout and gravel plant, as finally adopted is shown on Fig. 2. For a length of 3,758 feet of single-track tunnel under Willoughby, Fulton and Montague Sts., the average amount of gravel injected was 30.6 cu.ft. per ring, 2 ft. 2 in. in width, and the average amount of 1:1 natural cement grout injected was 32 bags per ring, equivalent to approximately 35 cu.ft. of set grout in place. The theoretic void outside the cast-iron lining, left by the passage of the shield was 31 a maximum thickness of 2½ in. where the grout had penetrated to a void under the main, caused by settlement of the underlying ground. As would be expected, there was considerably more grout in the soil over the timbered drift than in other parts of the cut. Although the grout penetrated freely through the smallest of fissures and cracks in the stiff stratum, there were no instances of grout mixed with the surrounding soil. Examples of the manner in which the grout penetrated this material are shown on Figs. 3 and 4. In these cases, as previously mentioned, the grout was injected at a pressure of 90 lb. per square inch. It is a matter of record also that thin neat grout, under the high pressure of 300 lb. per square inch would not impreg-

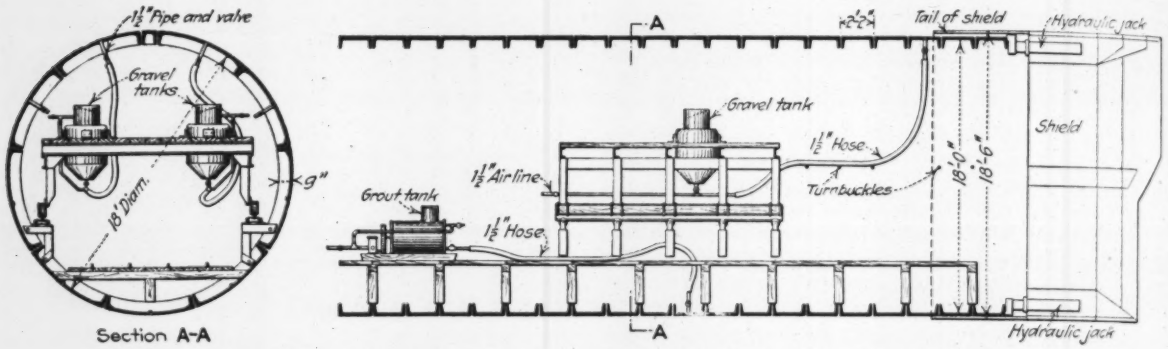



FIG. 2—ARRANGEMENT OF PLANT FOR PLACING GRAVEL PACKING AND GROUT

cu.ft. per ring. The actual cavity, however, was somewhat larger, owing to the ploughing action of the shield and to the loss of some material at the face of the heading.

The results obtained by the injection of gravel packing and cement grout as described above were very satisfactory, a maximum weekly progress of 118 feet having been reached in one tunnel. There was practically no settlement of the buildings along Willoughby St. and the settlement at the middle of the street, amounting to an average of 2½ in. on the car tracks, after the passage of both tunnels, was insufficient to require any repairs to the roadway. When it is considered that the cover over the tunnels averaged only 34 ft., and that the vibration from trolley cars, which operated at frequent intervals on the surface could easily be detected in the tunnel heading, the results obtained were distinctly noteworthy.

The grout found in the excavation for the Lawrence St. station was in evidence through the ground overlying the tunnels for the whole length of the cut, to a point about the level of the bottom of the 48-in. water main, which is approximately 16 ft. above the top of the tubes, as indicated in Fig. 1. In the stiff stratum of sand and clay, there were many examples of the grout penetrating to a void through a small fissure caused by the caving of the soil and filling that void. Many of these pockets were from 3 to 5 cu.ft. in volume, but two, at least, contained about 10 cu.ft. Some of these voids did not appear to be the result of the tunneling operations but were apparently in the ground before the shields reached this point. They may have been caused by old excavations. For a length of about 35 ft. in one place, and for short distances elsewhere, the underside of the 48-in. water main was covered with grout, having nate undisturbed fine sand, when the attempt was made on one of the river tunnel contracts.

In the loose sand and gravel below the stiff stratum, about the level of the tops of the tubes, a smaller amount of grout was found, usually in the form of small rounded lumps or knobs, the largest of which was about two feet in diameter. These lumps were generally in contact with the iron lining, near a grout hole, and most of them contained a small air hole running up through the middle to the top. The appearance of the grout found in the loose material was quite different from that which was found in the stiff stratum, where the caving action was sufficiently slow to permit the grout to penetrate and fill the cracks and fissures. There were no seams of grout in the loose sand and gravel, and no grout whatever was found in the sand between the tubes, below the level of the upper quarter point, except next to the iron lining.

Where the cast-iron tubes were uncovered, scattered patches of grout were found adhering to the iron lining on the upper quarter of the circle. Below the spring line, a much larger amount of grout was found adhering to the iron, there being several instances observed of a continuous envelope of grout varying from one to four inches in thickness, extending for a length of 25 to 30 ft.

In only one place was gravel observed at any distance from the iron lining. In this particular instance, the gravel was found to have penetrated to a distance of four feet from the tunnel. Considerable gravel, mixed with sand, was found spread out over the upper quarter of the cast iron lining, and wherever grout was found in this area adhering to the iron, gravel was found on the side of the grout away from the iron. This may have been caused by settlement of the roof of the tube,

FIG. 3—PENETRATION OF GROUT INTO SOIL
Looking at south side of excavation over timbered drift, about 7 ft. above top of tunnels. The boulders in the foreground were encountered in the cut. The location of this photograph is indicated by the letter Y in Fig. 1.

which sometimes occurs, and the formation of voids into which the grout penetrated, by the arching action of the overlying gravel. Near the spring line, the gravel was usually found in pockets unmixed with sand. One example was noted of a pocket of gravel over a grout line about three feet below the spring line, the pocket being ten inches in diameter and about one foot in length. The gravel in this knob was so closely packed that it stuck out from the cast-iron lining unsupported when the surrounding soil had been removed. Below the lower quarter point the gravel showed a tendency to spread out under the iron lining, but it did not mix with the surrounding sand as in the case of the gravel observed over the top of the tunnel. This difference was probably due to the fact that the gravel was injected into an open space below the tunnel, whereas it was injected into falling sand above. In only a few cases was gravel found mixed with grout.

FIG. 4—ANOTHER VIEW SHOWING GROUT PENETRATION
Photograph taken looking westward at point marked X in Fig. 1, about 75 ft. west of that shown in Fig. 3. This shows how the grout has filled the cracks and voids in the stiff sand and clay.

The general conclusion may be drawn that the method of injecting gravel was excellent for the purpose for which it was intended, that is, to fill the cavity behind the shield with a material providing immediate support for the surrounding soil; the overlying cover, about 34 ft., being thick enough to eliminate danger from the release of air at the high pressure of 90 lb. per square inch, necessary to inject the gravel. The gravel was particularly effective in arresting settlement of the ground overlying the tunnels. Simultaneous injections of gravel through all the grout holes in the upper part of the tunnel during the shove probably would have been an improvement in method. Grout penetrated and filled all voids not reached by the gravel, reducing to a large extent the settlement that otherwise would have occurred at the surface. The lack of any examples to indicate that the grout had penetrated the interstices between the particles of bank sand, again demonstrates that it is practically impossible to accomplish this under the conditions described above. The grout penetrated to and filled all voids but would not impregnate undisturbed sand.

The tunnels were constructed by Booth & Flinn, Ltd., under the supervision of the engineers of the Public Service Commission.

## Oldest County Concrete Highway in Iowa Promises Years of Service Still

DRIVING west of Mason City, Ia., on the old North Iowa Pike one passes on the second mile from the city over a mile of 16-ft. 6-in. reinforced-concrete pavement laid in 1913 by county day labor crews at a cost of 10,500, nearly $1 per square yard. The crown is 1¼ in. and the subgrade is a loose fluffy black soil which becomes mucky when wet. Reporting on pavement development in Iowa to the Iowa Engineering Society Raymond Zack, district engineer, Iowa Highway Commission, gave the following information as to this 10-year-old slab:

No tests were run on cement or the sand and gravel. Unwashed material was used. The sand came from a pit on Willow Creek and contained a heavy percentage of red clay. Since then culverts have been built near this pit and material hauled from Mason City, because the local deposit is unfit for such use. The coarse aggregate consisted of soft limestone, strippings from the local cement plant and of unwashed gravel abounding in shale and lumps of clay. The material was dumped on the subgrade and shoveled into wheelbarrows and hauled to the mixer. Two-inch wooden forms were used and the riding qualities of the surface are about as poor as the concrete itself.

This pavement has been in continuous service since laid. There are numerous transverse and longitudinal cracks which are, of course, kept filled with tar. During the last two summers several holes developed due to raveling of the concrete. Two on the west end of the mile near the center of the paving were filled with tar and gravel and cause no more trouble. One hole raveled out near the edge and a little later traffic broke through smashing out a triangular piece about 18 in. on a side. Another such piece broke out this last summer over an old wooden 1 x 1-ft. box culvert, which had been left in and is now badly decayed.

The action of the tires is causing some wear on this surface but by taking care of the places that ravel this pavement will serve for a good many more years. After it is unsatisfactory as a pavement it will be worth the original investment as a base for some more permanent type of resurfacing.

# New System of Sewage Treatment at Graham, Texas

## Septicization Precedes Activation—Storage Comes Automatically Into Use When Blower Shuts Off—Return Sludge Reduced—System Does Not Require Technically Skilled Operatives

By Henry E. Elrod
Consulting Engineer, Dallas, Tex., and Los Angeles, Calif.

SEPT-AER-SED is the name given to a new system of sewage treatment which was put into daily operation early in June, 1922, at Graham, Tex. As the name implies, the system comprises septic tanks, aeration chambers, and sedimentation chambers. The combination is the basis of patents issued Dec. 19, 1922.

The advantages of the Sept-aer-sed system of sewage treatment over the conventional activated-sludge process are: (1) The complete elimination of the troublesome excess activated sludge. (2) The small volume of air required for the production of a stable final effluent. (3) The lack of a necessity for technically skilled operatives. A plant of this type will treat 8 to 10 m.g.d. of strong municipal sewage per acre per day, with a volume of air less than that required for the usual activated-sludge plant, in the proportion that the reduction of suspended solids accomplished by the preliminary sedimentation in the septic tanks bears to the total suspended solids in the raw sewage. The operation of the plant produces no offense whatever and satisfactory operating results are obtained by intelligent, though not necessarily technically skilled, operatives. Considering the cost of the sludge conditioning and drying equipment and housing required in connection with the operation of the conventional activated-sludge plant, the cost of the Sept-aer-sed plant is materially less than that of the other type. With the elimination of sludge handling and drying costs, the reduction in the volume of air required, and the lack of a necessity for high-priced operatives, operating costs for the Sept-aer-sed system will also be very much less than those of the conventional activated-sludge process.

*Studies at San Angelo, Tex.*—The development of the Sept-aer-sed system of sewage treatment, as installed at Graham, is the result of studies and experiments carried on for several years at San Angelo, Tex., where an experimental plant of this type was installed in July, 1917, for the San Angelo Sewer Co. Conditions of topography in San Angelo were such that the only practicable location for a treatment plant was within a thousand feet of the business center of the city; there was no option, therefore, but to install an activated-sludge plant.

On the theory that the amount of air required for the oxidation of the suspended organic content of the sewage is proportional to the quantity of such organic matter in the sewage, a septic tank was provided for the reduction of a portion of the suspended solids and a proportional reduction of the air requirement was accomplished; it was not expected, however, that a greater reduction in the quantity of excess activated sludge would be produced than the proportional reduction of the suspended solids in the septic tank. The final effluent at San Angelo carried an average of 24 p.p.m. of solids; so when month after month no excess sludge was drawn off to be disposed of extraneously, it was thought that what excess sludge was being produced was passing off in the final effluent. Since these solids seemed to be inert, and caused no offense, no attention was paid to the matter until late in 1920, when analyses of the final effluent showed the solids to be cellulose-dissolved paper—which, being of lesser specific gravity than the sludge, floated out.

On discovering that the operation of the San Angelo plant produced no excess activated sludge, efforts were immediately made to ascertain the cause therefor. Until a better explanation of this phenomenon is advanced, the following one will stand: The amount of excess activated sludge produced by the aeration of raw sewage depends upon the amount and character of the suspended organic content of the sewage being aerated, the length of the period of aeration and the volume of air supplied, per unit of sewage.

*Septicization Before Activation*—In the ordinary activation-sludge process, raw sewage is admitted directly into the aeration chamber. This raw sewage contains fecal matter in large particles, together with greases, oils, and other trade wastes. Approximately 95 per cent of the air required for its aeration is effective only for the mechanical agitation of the sewage, to break up the larger particles of fecal matter and separate it from the greases, oils, trade wastes, etc. The remaining 5 per cent of the air is all that is necessary, ordinarily, for the oxidation of the finely comminuted organic content of the sewage. By placing a septic tank ahead of the aeration chamber, the reduction of a large portion of the solid content of the sewage is accomplished naturally; much of the suspended matter is changed, in the septic tank, to solids in solution, and practically all greases, oils, and trade wastes are retained in the tank. Those solids which do not settle out in the septic tank are very finely comminuted, anaerobically. Consequently, when the septic tank liquor enters the aeration chambers, practically the total volume of air supplied to it is effective as an oxidizing agent, very little being needed for mechanical agitation. This, in effect, is equivalent to reducing the suspended solid content of the raw sewage to a point where aeration, for a long period with a large volume of air, would produce biochemical oxidation to an extent which would eliminate the excess activated sludge.

Most of the difficulties, requiring constant attention and technical skill to overcome, encountered in the operation of the ordinary activated-sludge process are occasioned by the low stability of the sludge produced, the normal variations in the strength of the sewage, its variable rate of production, and trade wastes. In the Sept-aer-sed process, the sludge is quite stable, samples having stood in open and in closed containers, with and without water, for weeks without becoming septic. It dries readily and naturally without the least offense. The sludge is quite different, in practically all characteristics, from sludge produced by the aeration of raw sewage. Individual particles of the "floc" closely resemble small particles of sponge. Since practically all extraneous matter is retained in the septic tank, the sludge is clear and clean in appearance and is quite flocculent; its specific gravity is lower than

that of the ordinary activated sludge; however, the sludge settles rapidly and completely, or sufficiently so for all practical purposes.

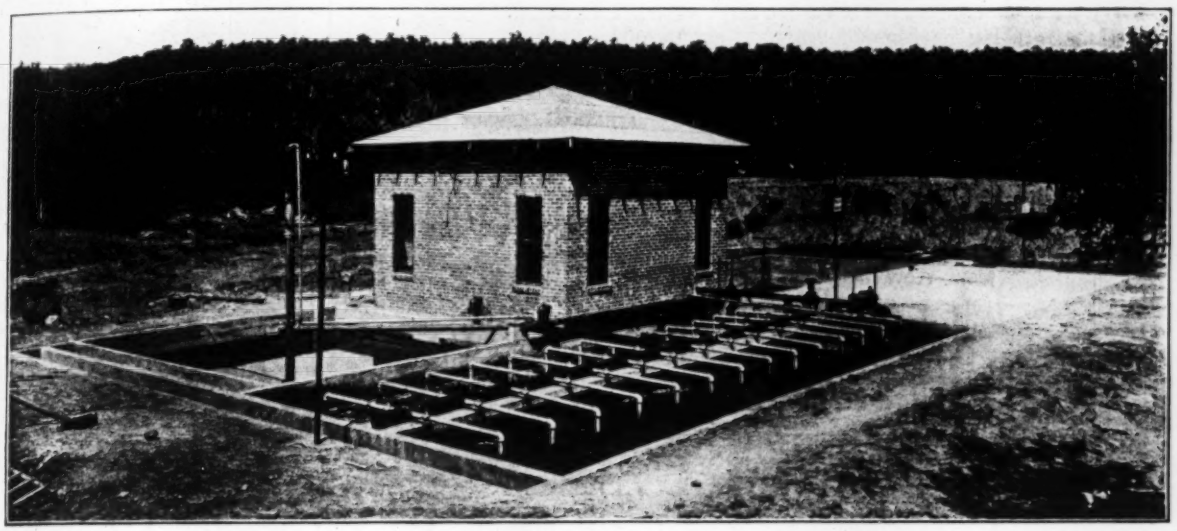
The effects of the variable strength of the sewage during different periods of the day are largely overcome in the septic tank, as the sewages of different strengths are mingled into a liquor of fairly uniform strength. By providing storage tanks in connection with the septic tanks, peak flows of sewage may be diverted thereinto, to be raised by lifts, operated by air from the aeration system during off-peak periods, thus smoothing out the peaks and valleys of the normal 24-hour production of sewage, so that a practically uniform volume of sewage of fairly uniform strength is charged into the aeration chambers continuously.

*The Graham Sept-aer-sed Plant* was designed to treat 0.3 m.g.d., of rather strong domestic sewage, but at the present time the plant is handling only an average of 0.143 m.g. daily. Because of the small flow the plant is being operated only eleven hours each day. Automatic control devices have been installed, so that the plant may shut itself down at 6 p.m., or at any predetermined time; it is only necessary for the operator to start the plant each morning, after which he may leave it without further attention until the next morning; or, the plant may be run continuously with no more attention than is necessary to keep the motor and blower properly oiled. For the present, however, this plant has a regular attendant during the entire operating period, to protect it from possible interference from curious visitors, and from mischievous boys.

In general, the plant consists of a grit chamber, septic tank, night-flow storage tank, two-compartment aeration chamber, final sedimentation chamber and a blower house.

*The Septic Tank* is of the Cameron type, but of special design. Seals, constructed near the inlet and outlet ends of the tank, entrap the gases produced by the anaerobic decomposition of the settling solids, which gases may be readily burned if at any time they are found to create offense. A compartment at the inlet end of the tank serves as a grit chamber. Means are provided for clearing the septic tank of its sludge, if and when sufficient sludge has accumulated to make its removal desirable. (The septic tank of the San Angelo plant, which is of similar design and which has been in operation for more than five years, had not, at last report, accumulated sufficient sludge to require cleaning. In fact, on Oct. 25, 1921, after 4¼ years operation, there was less than 9 in. of sludge on the floor of the tank.)

*The Night-Flow Storage Tank* is simply an open tank of sufficient capacity to contain the night flow of sewage (approximately 30 per cent of the day flow). During the day, the contents of this tank are transferred to the aeration chamber by means of a small centrifgual pump. In future plants of this type, which are intended to be operated during the day only, the sewage from the storage tank will be transferred to the aeration chamber by means of lifts, operated with air from the aeration system; if these lifts are controlled by floats, the liquor will be transferred in quantities varying with the normal day flow of raw sewage, thus smoothing out the peaks and valleys thereof.



GENERAL VIEW OF SEWAGE-WORKS AT GRAHAM, TEXAS

Covered septic tank in right rear, with storage tank for receiving septic effluent for night storage back of it. Activation tank with compressed air supply pipes at front, backed by sedimentation tank. Pump and blower house in center.

*The Aeration Chamber* is like those common to the activated-sludge process, but does not need to be as large as those usually employed, as sufficient aeration of the septic tank liquor may be effected in three to four hours. Grade S filtros plates, set with neat cement in pre-cast concrete plate holders, are provided for air diffusion. No trouble has been experienced with the plates clogging on account of the intermittent operation of the plant. The diffusion of air is apparently perfect and since there are no coarse, heavy solids in the liquor being aerated, this condition should obtain indefinitely. The ratio of filtros area to aeration chamber surface area is as 1 to 4.5.

*The Final Sedimentation Chamber* is of the conventional hopper-bottom type. On account of the comparatively low specific gravity of the sludge produced by the aeration of septic tank effluent the settling tank was designed to handle only 750 gal. of liquor per square foot of tank surface area.

*The Mechanical Equipment* of the plant consists of:

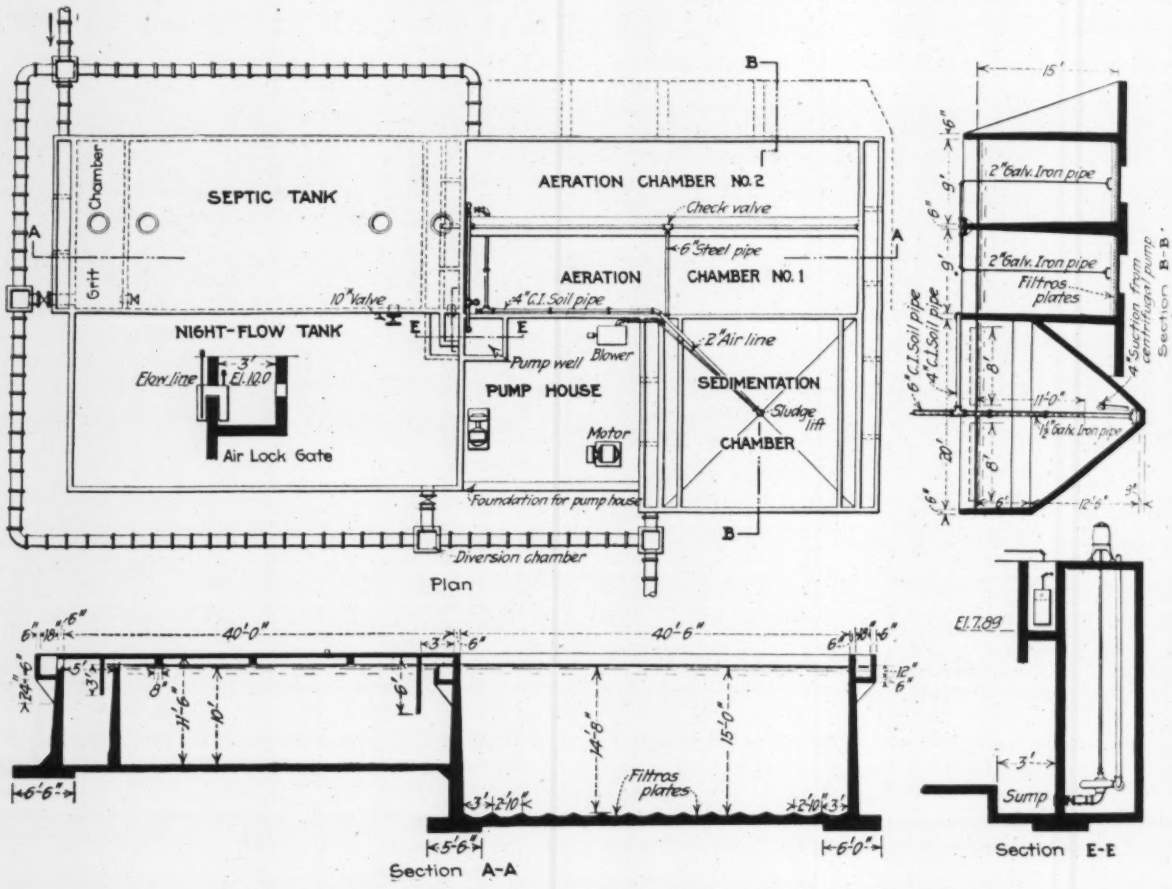
(1) A No. 3 Nash Hytor positive-pressure, belt-driven blower, actuated by a 15-h.p., electric motor. This blower has a normal capacity of 324 cu.ft. of free air per minute, under 7.5 lb. pressure, at 600 r.p.m. At present, this blower is being operated at 483 r.p.m., at which speed it compresses about 180 cu.ft. of free air per minute, under 7.5 lb. pressure. (2) A Swaby vertical, direct-connected, motor-driven, centrifugal pump, of 500-g.p.m., capacity. This pump is cross connected to each chamber and compartment of the plant and to the final effluent channel, so that the contents of any chamber, or compartment, may be transferred to any other chamber, or compartment, or to the final effluent channel. (3) A 100-g.p.m., Swaby horizontal, direct-connected, motor-driven, centrifugal pump. This pump is utilized to transfer the liquor from the night flow storage tank to the aeration chamber. (4) Automatic control devices, operated by air pressure from the blower. (5) A Bristol recording sewage-flow gage.

*Operation Sequence*—When the sewage-works are in use the septic tank effluent flows over weirs into the aeration chamber. When the plant is shut down the septic tank effluent is automatically sent to the storage tank. This is accomplished by means of an air-lock gate, set in the wall between the septic tank and the storage tank. As long as the blower is in operation, the gate is kept sealed by air therefrom. When the blower stops, the air in the "lock" is released through a channel cut in the seat of a valve in the connecting air line, and the liquor flows freely through the gate. On starting the blower, the gate is immediately sealed automatically, thus turning the flow of liquor into the aeration chamber again.

From the aeration chamber the liquor flows over weirs into the final sedimentation chamber, from which the clear effluent flows to a near-by water course. All of the settled sludge is continuously returned, from the hopper bottom of the chamber, to the inlet end of the aeration chamber, by means of an air lift.

*Analytical Results*—The accompanying table shows the results of analyses made by the Fort Worth Laboratories. Methylene blue stability tests of the final effluent were made at the plant from time to time, during the first few weeks of the operation of the plant. On account of the fact that there were many interruptions to the normal operation of the plant due to the "tuning up" of the machinery, etc., and of the fact that the septic tank had not been in operation sufficiently long to produce normal septic action, these tests were not uniformly satisfactory, but were not unsatisfactory during even short periods of operation when there were no disturbing conditions. Tests ordinarily showed color at room temperatures (80 deg. F. minimum to 102 deg. F. maximum) from 6 to 10 days and often for a much longer period.

*Operation Cost*—The present cost of operation of the Graham plant cannot be used as a fair criterion for that of other plants of this type, on account of the




PLAN AND SECTIONS OF "SEPT-AER-SED" SEWAGE-WORKS, GRAHAM, TEXAS

high cost of electric current and the comparatively small production of sewage at this time. Extensions to the city's sewer system of approximately 100 per cent, recently completed, will, it is expected, soon bring the production of sewage up to a volume approximating the normal capacity of the plant. For a plant of this type and size, operated at normal capacity, 560 kw.-hr.

ANALYSES OF RAW AND TREATED SEWAGE, GRAHAM, TEX.

(All in parts per million except as indicated)

| | Raw Sewage* | Septic Tank Effluent | Final Effluent |
|---|---|---|---|
| Solids: | | | |
| Total | 1,310 | 1,080 | 775 |
| Suspended | 460 | 375 | 11† |
| Alkalinity | 376 | .. | .. |
| Nitrogen: | | | |
| Free ammonia | | | 1.6 |
| Alb. ammonia | | | 0.018 |
| Nitrites | | | 0.400 |
| Nitrates | | | 0.500 |
| Oxygen consumed | | | 12.000 |
| Color | | | 40.000 |
| Odor, hot and cold | | | Musty |
| Turbidity | | | 10.000 |
| Stability, 4 days at 37° C. | | | 84% |

*Sample of raw sewage collected at 8.30 a.m.
†Cellulose; mainly toilet paper; most settles in three hours.

Another set of samples, collected the same day, showed chlorine, B. Coli and total bacteria as follows:

| | Chlorine P.P.M. | Bacteria B. Coli | Total per C.C. |
|---|---|---|---|
| Raw sewage | 335 | Present | 2,400,000 |
| Final effluent | 225 | Present in 0.01 c.c. | 10,000 |
| Creek above sewage-works outlet | 465 | Present in 0.0 c.c. | 600 |
| Creek below outlet | 235 | Present in 0.01 c.c. | 35,000 |

Mr. Elrod states that "the greater bacterial count in the creek water below the outlet than in the final effluent is due to by-passing raw sewage into the creek shortly before the report was made in connection with 'tuning up' the plant."

of current are required to treat 1,000,000 gal. of sewage with 0.66 cu.ft. of air per gallon of sewage treated. It is believed, however, that satisfactory results, under ordinary operating conditions, can be had with 0.5 cu.ft. of air per gallon of sewage treated. The blower in the Graham plant could not be economically operated at a rate of less than 0.66 cu.ft. of air per gallon of sewage, at which rate satisfactory results were produced.

The initial cost of the Graham plant was, in round figures, $16,000 exclusive of land. The plant has been approved for the Texas State Board of Health by V. M. Ehlers, state sanitary engineer. The plant was designed and the construction supervised by the Elrod Engineering Co., of Dallas, Tex., and the construction was done by the Janes Contracting Co., also of Dallas.

## Assessment of Street Resurfacing Costs

Information gathered from 163 cities by the Civic Affairs Committee of the Indianapolis Chamber of Commerce discloses four standard practices: (1) Total cost of resurfacing paid by city; (2) property owners and city contribute equally; (3) two-thirds of cost paid by abutting property owners, the remaining one-third by the city; (4) total cost paid by abutting property owners. Of 163 cities, 93 assess some portion of the cost of resurfacing on the property benefited. Of these 93, 39 assess the entire cost against the property benefited; 60 assess in excess of two-thirds of the cost, and the amount assessed in the remaining cities ranges from 25 per cent to 50 per cent. Seventy cities make no assessment against abutting property for resurfacing.

## Opportunities for Engineers in the U. S. Civil Service

FROM time to time, either organizations or educational institutions desire information as to the opportunities offered by the United States Civil Service Commission for engineers. Though no establishment of the government service has been charged with the collection of comprehensive data, a few figures are available which denote the range of engineering service.

In a letter from the United States Civil Service secretary to Prof. J. C. L. Fish, of the department of civil engineering, Stanford University, who had sought such information to convey to his civil engineering students, there were included the data herein given,

The secretary of the commission called attention to the disparity between salaries paid for the same engineering designations in different bureaus. His assertion is that "one of the outstanding complexities of the federal civil service is the lack of uniformity in pay for the same grade of work in different branches of the service." The reclassification bill passed at the last session of Congress, takes care of this wide disparity.

CIVIL ENGINEERING POSITIONS IN THE U. S. CIVIL SERVICE

(In most cases, employees at salaries of $2,500 or less, are allowed the increase of $20 a month granted by Congress.)

| Engineering Designation | Department or Office | Bureau or Branch | No. of Employees | Salary From— | Range To— |
|---|---|---|---|---|---|
| Civil engr. and supt. of constr. | War | Quartermaster | 15 | $1,800 | $3,600 |
| Civil engr. | | | 11 | 2,400 | 3,600 |
| | | Ordnance | 4 | 2,400 | 2,600 |
| | Treasury | Supervising Architect | 9 | 1,200 | 2,500 |
| | Interior | Reclamation | 114 | 2,400 | Up |
| | Interstate Com. Commission | | 125 | 1,320 | 9,000 |
| | Agriculture | Forestry | 1 | 2,000 | |
| Asst. civ. engr. | War | Engineer | 180 | 2,100 | 4,500 |
| | Interior | Reclamation | 84 | 1,500 | 2,280 |
| Asso. civ. engr. | Commerce | Standards | 2 | 2,200 | 2,400 |
| Jr. civ. engr. | War | Engineer | 265 | 1,500 | 3,000 |
| Civ. eng. aid | Navy | Yards & Docks | 8 | day 10.00 | 14.16 |
| Sr. highway engr. | Agriculture | Public Roads | 86 | 2,500 | 3,600 |
| Highway engr. | | | 91 | 2,100 | 2,900 |
| Sr. highway bridge engr. | | | 11 | 3,000 | 3,500 |
| Highway bridge engr. | | | 9 | 2,100 | 3,000 |
| Jr. highway bridge engr. | | | 3 | 1,620 | 2,100 |
| Sr. irrigation engr. | | | 7 | 2,000 | 3,000 |
| Irrigation engr. | | | 6 | 1,800 | 2,220 |
| Sr. drainage engr. | | | 11 | 2,500 | 3,000 |
| Drainage engr. | | | 5 | 2,100 | 2,500 |
| Jr. drainage engr. | | | 1 | 1,680 | |
| Junior engr. & deck officer | Commerce | Coast and Geod. Survey | 70 | 2,000 | * |
| Chief of road survey party | Agriculture | Public Roads | 40 | 1,800 | 2,100 |
| Supervisor of surveys | Interior | Land Office | 1 | mo. 300 | |
| Asst. supervisor of surveys | | | 10 | mo. 250 | |
| Cadastral engr. | | | 63 | mo. 155 | 200 |
| Surveyor | | | 37 | mo. 125 | 150 |
| " | War | Engineer | 43 | 1,500 | 1,800 |
| " | Agriculture | Forestry | 27 | 1,400 | 2,200 |
| Transitman | Interior | Land Office | 30 | mo. 100 | 120 |
| " | Agriculture | Public Roads | 52 | 1200 | 1,800 |
| Topographic draftsman | War | Air | 2 | 1,400 | 1,800 |
| " | | Quartermaster | 1 | 1,800 | |
| " | Interior | Reclamation | 14 | 1,500 | Up |
| " | | Geological Survey | 36 | 1,800 | 2,700 |
| " | | Land Office | 57 | 1,000 | 2,340 |
| " | Agriculture | Soils | 13 | 1,200 | 1,800 |
| " | | Forestry | 10 | 1,300 | 2,160 |
| " | Commerce | Coast & Geod. Survey | 34 | 1,200 | 2,900 |
| " | Post Office | | 24 | 1,200 | 2,000 |
| " | Navy | | 14 | day 6.72 | 10.00 |
| Highway drafts | Agriculture | Public Roads | 22 | 1,200 | 1,800 |
| Draftsman | War | Engineer | 115 | 1,500 | 3,000 |

* Promotion to commissioned grade.

# Headwalls for Pipe Culverts

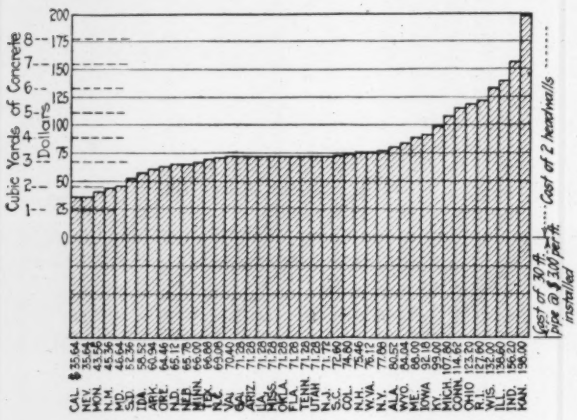
## Wide Range in Designs—Light Walls Satisfactory in Warm and Cold Climates—Headwalls Not Always Necessary

By Howard See

President, Dixie Culvert & Metal Co., Atlanta, Ga.

FROM the very beginning of systematic road building, pipe culverts have been used extensively. While the culverts on any particular road job represent a relatively small percentage of the total cost of the job, yet in the aggregate the amount of money annually spent on culvert installations runs well into the millions, an item which justifies the necessary study to develop the most economical designs and practices.

An investigation of the headwall designs for pipe culverts as shown by the standard drawings of the various state highway departments produces some very




YARDAGE AND COST OF TWO HEADWALLS

Showing variation in practice of state highway departments. Cost computed at $22 per cu.yd. for concrete.

interesting comparisons. The author obtained from each state highway department copies of its headwall designs, and tabulated the amount of concrete required for the various diameters of culverts according to the standards of the various states. The table shows great variations.

A 24-in. culvert may be considered of average size; comparisons made on it, which are typical of those that might be made of other sizes, have been charted in the accompanying diagram. According to the standards of California there is required for the two headwalls 1.62 cu.yd. of concrete. The amount required by Nevada is the same. This is the lightest headwall of any of the states. Georgia, Arizona, Louisiana, Mississippi, Oklahoma, Florida, Tennessee, Utah and New Jersey require 3.24 cu.yd., or twice as much; Indiana 7.1 cu.yd., and Kansas 9.0 cu.yd., over five times as much as California. This comparison is made on straight or flat headwalls, and the same relation would not exist between the yardages of the wing-wall type or the U type. However, the straight type is the one most generally used, the others being generally used only to meet some special condition.

At first sight it seems likely that the mild winters of California make possible a lighter headwall than is necessary in states having harder winters. But Idaho, South Dakota, North Dakota, and Montana use the lighter headwalls, and yet these are states in which the winters are most severe. It is a reasonable assumption that the lighter headwalls would be satisfactory in other states and that those states which have the heavier designs could make substantial savings by revising their standards accordingly.

*Headwalls Not Always Necessary*—A discussion of the design of headwalls for pipe culverts brings up the question of when headwalls are and when they are not necessary on a pipe culvert installation. It is general if not universal practice in all states to build headwalls on all pipe culverts. It has been a requirement on Federal Aid roads. Are these headwalls a real necessity in all cases? In many instances the cost of the headwalls is greater than the cost of the culvert pipe installed, so that the cost of the culvert installation would be reduced by at least half if the headwalls were omitted; even in those states in which the lighter headwalls are used the possible saving would be very substantial.

A study of this subject has brough the author to the conclusion that the headwall is not universally necessary, and that where it is not a necessity it should be omitted. The function of the headwall is, of course, to act as a retaining wall and to prevent the erosion of the fill or subgrade in which the culvert is installed. In a great many cases this could be done better and at the same time more economically by the substitution of additional length of pipe for the headwall. This would be particularly practical in the case of the downstream end, for here the important function is getting the water away from the toe of the fill as quickly as possible and with as little erosion as possible.

In railroad construction it is the practice to omit headwalls on pipe culverts except where some special local condition makes their use necessary. This is significant for the reason that railroad engineering is very much older than is highway engineering, and that economies of design have naturally been much more completely worked out. The chief engineers of several of the leading railroads of the country were consulted on this point, and in general they agreed that the headwall is not a universal necessity on pipe culvert installations and that the general practice should be not to build headwalls except where it is required by some local condition.

The omission of headwalls would not be equally practical on all types of pipe culverts. Those types which are installed in short lengths more definitely require headwalls than those which are installed in greater lengths, such as cast-iron pipe, or more particularly, corrugated pipe. The short-length pipe, not being mechanically bound together, would have a tendency to cause trouble by undercutting of the end section, which would cause it to disconnect itself from the adjacent section, after which the same action would be repeated. That type of culvert pipe which is mechanically a one-piece construction lends itself admirably to the omission of the headwall. This is particularly true on the downstream end, for long lengths of cast-iron pipe or corrugated pipe can be so installed that the end can act as a cantilever, overhanging the fill or bank by several feet if necessary. This permits the culvert to discharge its water well clear of the toe of the fill, thereby reducing erosion or undercutting to a minimum. Such construction as this is not particularly novel, being frequently used on railroad construction.

It is the aim of the author to direct the attention of

highway engineers to two points: first, the desirability of revision of standards in many states in order that headwalls might be built of lighter design; second, the desirability of omitting headwalls where they are not necessary. The latter would mean that each individual installation would have to be analyzed on its merits and that the general policy of requiring headwalls in all instances should be abandoned. Instead, greater responsibility and discretion should be placed on the local engineer. He should determine where headwalls are necessary and where they are not necessary. There is no reason why this practice, general in railroad work, would not be applicable in highway construction.

## Effective Joint Filling Methods in Brick Paving

By J. F. Gallagher
Asphalt Sales Department, The Texas Co., New York

Effective methods of applying asphalt joint filler in brick paving as exemplified in work done last year at Decatur, Ill., appear to have been developed by Walter C. Schwartz of Bloomington, Ill., a contractor specializing in this operation.

Having taken care of the preliminary features, such as sweeping the brick, the initial application of asphalt is made over an area of about 200 square yards. This partly fills the joints and leaves a thin film on the surface of the brick. After the asphalt has been given an opportunity to cool, it contracts so that the joints are only about half filled. Then follows a second application over the same area, which is intended to fill the joints flush and slightly increase the thickness of the surface coating on the brick. As applied the asphalt is flush but upon cooling it contracts and drops slightly below the general level. In order to bring this

FILLING JOINTS WITH SQUEEGEE MACHINE
Applying asphalt filler to a brick pavement by a squeegee machine insures a more uniform and effective application.

flush with the squeegee coat, a third application is made after which the pavement presents a smooth uniform appearance.

As will be found in almost any job of brick paving, there are usually a few brick the corners of which have been broken off in handling, or which may have been laid a little farther apart than the others. Of course, such places require a greater amount of filler in order to eliminate the holes or relatively open joints. To take care of such spots, they are "pointed up" by means of the old-fashioned cone-shaped pouring can. After "pointing up," dry torpedo sand is spread in the usual way, and while hot sand is to be preferred, good results have been obtained in warm weather from the use of dry torpedo sand or stone chips free from dust.

POINTING UP A BRICK PAVEMENT
The last of three steps in securing complete filling of the joints between the brick.

One might gain the impression that the successful procedure as above outlined would entail the use of considerably more filler and a greater labor cost than the ordinary single-application method. However, Mr. Schwartz states that from his experience he has proved he does not use any more material than the average contractor in a single application. This he attributes to his squeegee machine method of applying the filler which enables him to go over the area much more rapidly than by the hand squeegee method. The second and third applications require very little material, and for the reason that the machine must of necessity be pulled over the pavement at a rapid rate in making these applications, the labor cost is low.

The accompanying views illustrate the methods referred to as practiced at Decatur, where Mr. Schwartz was sub-contractor, the general contractor being File & Collins of Decatur. The asphalt used on this work was Texaco No. 39 paving filler.

Attention might be drawn to the type of squeegee machine used, which is regarded by the contractor as being largely responsible for the success he has had in filling brick pavements. It enables the operator to apply as much or as little material as desired, the amount spread being regulated by the speed with which it is drawn over the pavement. Also due to the fact that the hot material is spread as soon as it strikes the pavement, a very uniform finish can be obtained. In this respect the writer considers it far superior to the ordinary hand squeegee, as it eliminates to a large degree the possibility of a large amount of hot material being poured over the pavement before it can be squeegeed into the joints. Where this occurs the material chills quickly, forming a relatively thick mat on the surface of the pavement, and instead of filling the joints, simply bridges them.

### Motor Maintenance in Detroit Water-Works

The seventy-eight automobiles owned by the Detroit Water Department traveled during the year ending June 30, 1922, 584,371 miles, used 71,493 gal. of gasoline and 4,787 gal. of oil at a total cost of $72,883. This figure includes maintenance, depreciation, interest on investment but not garage rental. Of the 78 cars 25 are passenger, 30 commercial and light delivery and 23 trucks of from 1 to 6 tons capacity.

# Successful Malaria-Mosquito Work at Carbondale, Ill.

## State, City and Railroad Combine to Drain Swamps, Clear Ditches and Oil Ponds—Control of Rain Barrels and Wells

COMPARATIVELY high death rates from malaria in southern Illinois (10 to 30 per 100,000 in different counties) have led the State Board of Health to undertake measures for eliminating the malaria mosquito. The methods employed at Carbondale, in Jackson County (death rate 11 to 15), were described recently in a paper before the Illinois Society of Engineers by Harry F. Ferguson, chief state sanitary engineer, and A. F. Dappert, assistant sanitary engineer. An abstract of this paper is given in the following paragraphs.

In Jackson county there are from 2,700 to 3,000 cases of malaria annually. Assuming the economic loss per case at $100, which would be a conservative figure and would include the cost of medicine, doctor bills and loss in productive earnings, the annual economic loss to the county is more than $250,000. That county could well afford, therefore, to spend a large sum yearly until mosquito breeding places have been eliminated. The eradication of mosquitoes is the most effective method of malaria control and drainage is the most effective anti-mosquito measure.

At Carbondale the campaign was directed against the malaria mosquito but included all species and was very successful. In 1921 there were 267 cases of malaria in the city, or 4.26 per cent of the population. At the end of the season's work a house-to-house canvass showed nineteen cases, or 0.3 per cent of the population affected during 1922. The doctors estimated fifty-four cases for 1922, but even so, the reduction in malaria has been great as a result of the first season's work. Mosquito breeding places included about 60 acres of cat-tail swamps on the north side, a 40-acre lake on the south side, a number of small ponds, and about six miles of ditches and streams, all within mosquito-flight-distance of the city. Further, there was an enormous number of rain barrels and open wells and cisterns. The Illinois Central R.R. provided for the drainage of the cat-tail swamps, while the International Health Board paid one-third and the Lions Club two-thirds of the remaining expenses, except the general supervision by state sanitary engineers.

For the drainage of the swamps the Illinois Central R.R. constructed 9,000 ft. of ditch by the dynamite process for about $1,200, or less than half of the estimated cost by hand labor. A crew of six men and one foreman completed the work in fifteen days. The ditch had an average cross-section of about 10 ft. top width, 2 ft. bottom width, and 3½ ft. depth; its cost was approximately 17c. per cu.yd.

The 40-acre lake on the south side was abundant with cat-tail growth and pond lilies in a number of small bays, and there was also a fine growth of grass around the edges of the lake, making it an ideal breeding place for mosquitos. The water level in the lake was dropped 18 in. by cutting the outlet wall, and a great reduction in breeding was at once apparent. The bays were cleared of the cat-tails and pond lilies, and portions of the surface and the edges were oiled throughout the season. A careful examination in September failed to find any breeding, when in May, before the work started, as many as 200 larvae could be secured in a single dip with a small dipper. Ditches and streams in the area were carefully regraded, cleared, and kept in proper condition for oiling. All ditches and other collections of water in the area were oiled once each week. Frequent inspections showed that almost perfect control was established on natural breeding places.

Control of rain barrels and other man-maintained breeding places was the most troublesome part of the campaign. In June, out of 664 open wells and cisterns, breeding was found in 391, and of these 584 were immediately stocked with Gambusia. A later inspection of sixty wells and cisterns showed that the fish were performing their duties well; only two cisterns were found breeding and the fish had apparently been removed from these. The control of rain barrels and tubs was accomplished by regular house-to-house inspections. In June the first inspection showed 1,030 containers, 831 being rain barrels and tubs which were found breeding mosquitoes. The second inspection in June caught 296 containers breeding. The third inspection 154, and the fourth inspection 206. For the fifth inspection every container holding water in the city was oiled. The next three inspections caught nineteen, seven and eleven containers breeding. By the height of the mosquito season, almost perfect control had been established.

The cost of work, not including the supervision by state sanitary engineers, or of the work done by the Illinois Central R.R., was $1,599, or about 25c. per capita. The total cost, including that of the railroad work and allowing for the State sanitary engineer's time and expenses, was about $4,260, or 68c. per capita. The work resulted in the prevention of at least 200 cases of malaria and relief from the mosquito nuisance. If each case of malaria is figured at $100 (and the Illinois Central R.R. was willing to spend $8,000 to prevent some 125 cases annually among its employees), the net saving to Carbondale from the reduction of malaria alone was at least $15,700. This charges off the entire cost of the ditching and other work of a permanent character against the first year's economic saving resulting from freedom from malaria. By less expenditures in future years, greater economic savings will thus prevail.

Moreover, the draining of the swamps and repairing of ditches and drainage channels has increased the value of the lands affected.

## Leaching Action of Water on Zinc Chloride

ALTHOUGH zinc chloride is one of the most effective of wood preservatives it will not give permanent protection. Under the action of water this preservative loses its strength in two ways. In time a considerable amount of the solution is leached out of the wood, and that remaining is not of sufficient strength to be effective. It has also been brought out in a study of preservatives at the Forest Products Laboratory that water eventually causes a chemical decomposition of zinc chloride by the removal of excess chlorine.

Samples of ties analyzed after service had a zinc content equivalent to 0.4 lb. of zinc chloride, with scarcely enough chlorine present for 0.08 lb. of zinc chloride per cubic foot. Treated blocks leached for a month at the laboratory lost about 90 per cent of their chlorine content and only 70 per cent of their zinc.

The disappearance of the chlorine from zinc chloride explains decay which has been found in treated ties and timbers which still have high zinc content. Although the zinc is the toxic or poisonous part of zinc chloride, it is not effective against the fungi which cause decay unless it is combined with some acid radical which makes it soluble. In consequence, in analyzing zinc-chloride-treated wood after service it is necessary to determine both the chlorine and zinc content in order to calculate the amount of preservative solution present in the wood.

Even then only a very rough estimate can be formed, for some of the chlorine which would be obtained in the analysis is in the wood in the form of an insoluble basic chloride of unknown composition.

# Methods for Determining Street Pavement Crowns

## New Crown Formula Presented—Symmetrical and Unsymmetrical Distribution Explained—Inverted Crowns for Alleys

By F. S. Besson

Major, Corps of Engineers, U. S. A., Assistant to Engineer Commissioner, District of Columbia

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DIFFERENT methods of procedure are followed in establishing street crowns where the street and its intersections are at the same level and where they are at different levels and also in the case of alley pavements where there are no curbs and gutters. In the following discussion a new and simple crown formula is suggested and crown distribution is considered (1) when distribution is symmetrical, (2) when distribution is unsymmetrical and (3) for alley pavements with inverted crowns.

*New Crown Formula*—There are many rules for determining roadway crowns, one of the best known being

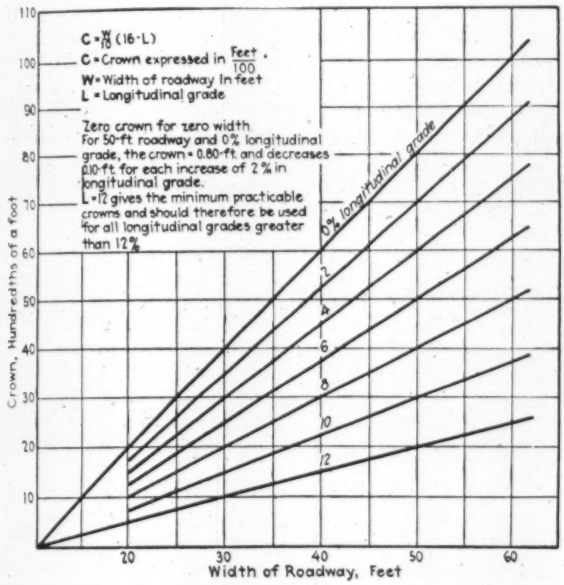



FIG. 1—CROWN DIAGRAM FOR STREET PAVEMENTS

Dare's formula, which has been in use many years and gives excellent results:

$$C = \frac{W(100 - 4L)}{6{,}300 + 50L^2}$$

In this formula $C$ = crown in inches; $W$ = width of roadway in inches, and $L$ = longitudinal grade expressed as a percentage. The crown decreases as the longitudinal grade increases. Some formulas require more crown for asphalt surfaces than for other types, while other rules require the opposite. In order to carry water quickly to the gutters, it is evident that more cross slope should be given a rough absorbent type of pavement than a smooth non-absorbent type. Steep cross slopes give a sidewise tilt to vehicles and make the effects of a slippery pavement felt more than do slight slopes. However, the pavements suitable for city use, are practically all in one class as far as smoothness is concerned and the question of cross slope

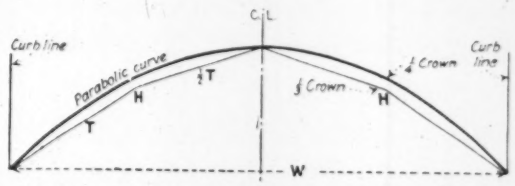



FIG. 2—COMPARISON OF PARABOLIC DISTRIBUTION OF CROWN WITH THAT BY FORMULA $T = 0.266\ (16 - L)$

may well be settled by the adoption of a single crown formula. One of simple application and a practicable mean of those in general use is as follows:

$$C = \frac{W}{10}(16 - L)$$

For example, for a 50-ft. roadway and 4 per cent longitudinal grade

$$C = \frac{50}{10}(16 - 4) = 60$$

that is, 0.60 ft. since $C$ = crown in $\frac{\text{ft.}}{100}$; $W$ = width of roadway in ft.; $L$ = longitudinal grade. The foot, since all field work is carried out with that unit, is used rather than the inch.

The diagram, Fig. 1, gives the crown in accordance with this formula, from below 24 ft. which width is a minimum suitable for residential local streets, to above 56 ft. which width is approximately the maximum necessary for a traffic highway. For a wide rapid transit street the width of the car tracks is omitted in applying the formula. For example, a 72-ft. roadway with 16 ft. subtracted for car tracks would require the same crown as a 56-ft. traffic highway. The transverse slopes are laid off from the outside rails toward the gutters while the entire track space is a tangent connecting the slopes. If extra slope is given the gutters, they should be considered separately from the roadway. The crown then should be computed from the top of the gutter slope and the roadway width taken exclusive of the gutters.

*Symmetrical Distribution*—The details of the following method for crown distribution are based upon the crown formula,

$$C = \frac{W}{10}(16 - L).$$

When the gutter lines are at equal elevations, the high point of the crown is at the center of the roadway. Other points on the cross-section are often determined

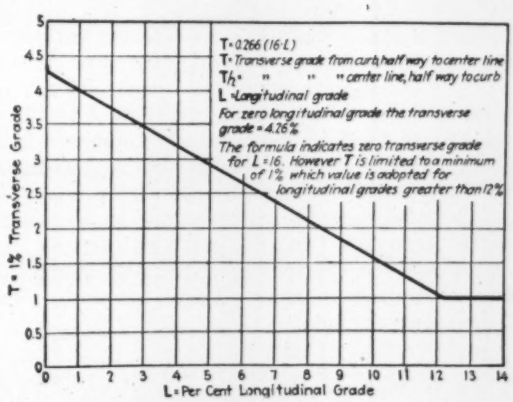

T = 0.266 (16-L)
T = Transverse grade from curb, half way to center line
T½ = " " " center line, half way to curb
L = Longitudinal grade
For zero longitudinal grade the transverse grade = 4.26%
The formula indicates zero transverse grade for L = 16. However T is limited to a minimum of 1% which value is adopted for longitudinal grades greater than 12%
T = 1% Transverse Grade
L = Per Cent Longitudinal Grade
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

FIG. 3—TRANSVERSE SLOPE DIAGRAM FOR THE FORMULA $T = 0.266\ (16 - L)$

by the parabolic formula, which gives a drop of one-fourth of the total crown at a point half way between the center line and the curb. A better distribution is obtained if a drop of one-third is made at the half-way points as shown at $H$, Fig. 2. The remaining two-thirds of the crown is then dropped between $H$ and the curb. This plan gives a transverse grade percentage from $H$ to the curb double that from the center line to $H$.

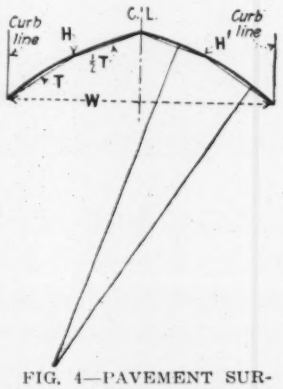



FIG. 4—PAVEMENT SURFACE REPRESENTED BY CIRCULAR ARCS THROUGH POINTS ESTABLISHED BY $T = 0.266\ (16 - L)$

$$T = \text{per cent grade } H \text{ to curb} = \frac{\frac{3}{8}\text{ crown}}{\frac{1}{4}\text{ width}} = \frac{\frac{3}{8}C}{W}$$

$$\frac{T}{2} = \text{per cent grade center line to } H = \frac{\frac{1}{8}\text{ crown}}{\frac{1}{4}\text{ width}} = \frac{\frac{1}{4}C}{W}$$

From the preceding equations it is seen that

$$C = \frac{3}{8}TW$$

Substituting this value for $C$ in the crown formula,

$$C = \frac{W}{10}(16 - L)$$

The following is obtained: $T = 0.266(16 - L)$. For example, with a 1 per cent longitudinal grade $T = 0.266 \times 15 = 4$ per cent. The transverse grade varies only with $L$, the longitudinal grade. Thus there is but one value of $T$ for all widths of roadways as long as $L$ is constant. The relationship of $T$ and $L$ is shown by the diagram, Fig. 3.

Having drawn in the transverse grades the actual cross-section of the finished roadway may be shown by drawing arcs of circles through the center line and the gutters as illustrated in Fig. 4, $T$ and $\frac{1}{2}T$ being chords of the arcs. For work in the field, if the roadway width is less than 40 ft., in addition to laying out the gutters, only those elevations at the center line and at the greater points, that is between $\frac{1}{2}T$ and $T$, need be given. Workmen have no difficulty with a crown if grade pegs are at approximately 10-ft. intervals. If the roadway is wider than 40 ft., elevations may be scaled to the arc on the cross-section in order that intermediate grade pegs may be set.

In Figs. 2 and 4 the vertical scale is greatly exaggerated in order that it may be easily seen how the parabolic curve differs from the straight lines $T$ and $\frac{1}{2}T$, and how closely the cross-section based upon $T = 0.266(16 - L)$ follows these lines. Compared to the parabolic curve, this cross-section on the drawing appears to give a sharp break at the center line which, in reality, however, is imperceptible in a roadway. While the departure from the parabolic curve is small, the $T$ formula gives better crown distribution and great ease of application in actual practice. It may be noted that the crown formula,

$$C = \frac{W}{10}(16 - L)$$

is of secondary importance, since the transverse slope formula is sufficient for laying out cross-sections and in fact, for unsymmetrical roadways its use is the only satisfactory method.

*Unsymmetrical Distribution*—An unsymmetrical distribution of crown is necessary when land abutting one side of a street is higher than that on the other. This occurs whenever a street is built on the side of a slope. Cross streets cause the gutters at the intersections to be higher on the up-hill side than on the down-hill side. Between intersections, property on the up-hill side is above that on the lower side. Sidewalk and curb are also higher on the up-hill side; and, unless the accompanying gutter is placed higher than that on the down-hill side of the street, a very unsatisfactory appearance results.

Sometimes there is a mistaken idea that roadway cross-section must be symmetrical, with gutters on the two sides of a street at equal elevations; and, in order to attain this, steep slopes have been given sidewalks on the up-hill side. Also, curb has been set with extra height, above the gutter, showing as much as a foot whereas 0.55 ft. should be a maximum even in most exceptional cases. These expedients when made use of to a reasonable degree are helpful but they should not be applied to the extent of placing the up-hill gutter at the same elevation as the down-hill one. A difference in elevation is necessary in order to give a side slope street a good appearance. An unsymmetrical crown can be designed and constructed in the field just as easily as a symmetrical one.

The formula, $T = 0.266(16 - L)$ for the transverse grade, which has already been explained, is also used for unsymmetrical roadways; and, therefore, its value can be taken from the diagram, Fig. 3. The high point of the crown, however, is not in the center of the roadway. The cross-section may be laid out as in the following example. In Fig. 5, the elevation of the low

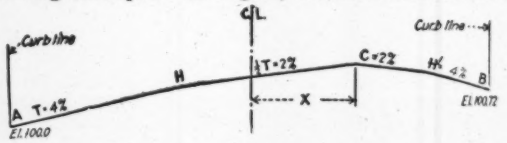



FIG. 5—UNSYMMETRICAL DISTRIBUTION OF CROWN

gutter is 100 ft., that of the high gutter, 100.72 ft. The roadway is assumed to be on a 1 per cent longitudinal grade; and, therefore, from the diagram, Fig. 3, $T = 4$ per cent. Three per cent is the mean slope from $A$ to $C$ and is the same as that from $C$ to $B$; but the rise $A$ to $C$ is 0.72 greater than the fall $C$ to $B$. The distance $A$ to $C$ is greater than $C$ to $B$, by a number of feet equal to 72 divided by the mean slope, or $\frac{72}{3} = 24$ ft. Suppose the roadway width to be 56 ft. then: $2CB + 24$ ft. $= 56$ ft., $CB = 16$ ft. and $AC = 40$ ft. Furthermore, it should be noted that the distance from the center line to $C$ equals 12 ft. $= \frac{72}{6}$ or the difference in gutter elevations divided by $T + \frac{1}{2}T$. Elevations at the points $H$, $C$, and $H'$ are easily computed, for example; $H = 100 + 4$ per cent of $20 = 100.80$ ft., $C = 101.20$ ft., $H' = 101.04$ ft.

The increase in elevation to be given the high gutter above that of the low gutter is a matter of judgment and should be at least sufficient to give smooth connections at the street intersections. There is a limit to the extra elevation that may be given the high gutter. In Fig. 5, as the gutter at $B$ is raised $C$ approaches $B$

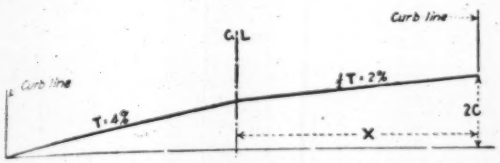



FIG. 6—MAXIMUM EXTRA ELEVATION FOR THE HIGH GUTTER

and coincides therewith when $H$ is at the center line of the roadway. In such cases the cross-section is as in Fig. 6 and the limit of extra elevation of the high gutter equals twice the crown given by the formula

$$C = \frac{H}{10}(16 - L)$$

To sum up; for an unsymmetrical distribution of crown, where $E$ = difference in elevation, stated in hundredths of a foot between the gutters, and $X$ = the distance, in feet from the center line of the roadway to the high point of the crown:

$$T = 0.266(16 - L)$$

$$\frac{E}{1.5T} = X$$

For example, if $E = 0.72$ ft. and $T = 4$ per cent $X = \frac{72}{6} = 12$ ft.

Maximum value for $E = 2C$.

Where $C = \frac{W}{10}(16 - L)$.

*Alley Crowns*—Ordinarily no curb is used with alleys and this means that an inverted crown has to be used, that is, a dished cross-section with a longitudinal gutter in the center of the alley. The cross-section can be platted by using, as shown in Fig. 7-A, equal transverse slopes from the edges of the alley to the bottom of the gutter.

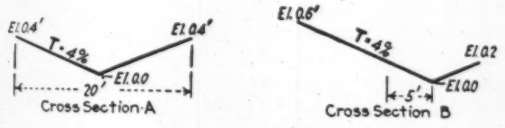



FIG. 7—ALLEY CROSS-SECTIONS

If an alley is on a side slope and it is desired to have one edge higher than the other, the cross-section may be platted as in Fig. 7-B. The horizontal distance from the low point of the gutter to the center line of the alley is obtained by the formula $X = \frac{E}{2T}$ where $E$ = difference in elevation, stated in hundredths of a foot, between the edges of the alley, and $X$ = the distance in feet from the center line to the low point of the gutter. For example, if $E = 0.4$ ft. and $T = 4$ per cent, then $X = \frac{40}{2 \times 4} = 5$ ft. The gutter should not be closer to the edge than the quarter point, therefore with an alley width of 15 ft. and $T = 4$ per cent, a value for $E$ of as large as 0.4 ft. should not be used since with $X = 5$ ft. the low point of the gutter would be within 2½ ft. of the alley edge.

Where an alley entrance is from a street that is on a steep grade there may be considerable difference in elevation from the sidewalk at the up-hill edge of the alley to the down-hill edge. Some of this difference in elevation may be taken care of by providing a step or curb along the up-hill edge, between the sidewalk and alley paving.

Merging the grades of two portions of an alley at a change in direction or intersection is done in the same manner as for streets and being not nearly so difficult no explanation is necessary. At an alley exit the alley gutter should be gradually done away with so that the transverse grades of the alley will merge with the gutter grades of the street in an unbroken straight line, thus permitting the street water to flow properly in its gutter.

# Using Divers and Compressed Air in Underpinning

## Unusual Means Employed to Underpin Brick Party Wall, 10 Stories High, During Boston Bank Building Construction

AN UNUSUAL method for sinking small concrete caissons to underpin the wall of a heavy ten-story office building was recently devised and applied in Boston with great success.

In the construction of the new First National Bank building, Milk and Devonshire Sts., the party wall of the adjoining Massachusetts Trust building at the

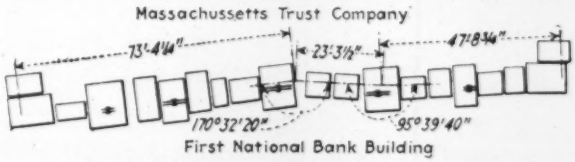



FIG. 1—PLAN OF UNDERPINNING CAISSONS

south end of the bank site had to be underpinned. This is a brick wall, ten stories high and 3 ft. thick in its lower portion, which is carried on an I-beam grillage, about 35 ft. below sidewalk grade. The grillage also carries the steel columns which support the floor system. At this point the hardpan, which is the original glacial till of hard packed sand and boulder clay, is found at approximately El. —37, or 57 ft. below sidewalk, and is overlaid by a stratum of very fine sand 8 to 10 ft. thick. Overlying this sand is blue clay. As the trust company building was occupied, any settlement, disturbance or cracking had to be avoided.

Experimental work developed the fact that the sand stratum was under sufficient hydraulic head to make necessary going through it by some method that would insure no loss of ground and at the same time form the new basement retaining wall and provide support for the new and existing loads along the property line. The depth under the existing grillage at which hazardous bottom conditions were found varied considerably from one end of the wall to the other. The methods by which the work was done are as follows:

The wall length was divided into conveniently short sections, and a caisson designed the width of each section. Prior to starting a caisson under any particular section, the load on this section was picked up by cantilever needling and transferred to the adjacent grillage areas to insure the safety of the old brick wall during construction, as it was not in good shape. Care was taken in opening up new sections not to overload the blue clay under the grillage.

A starting pit was then sunk directly in front of

the grillage to a depth below its bottom sufficient for access. This was then enlarged by tunneling back under the grillage the proper width and depth for the caisson, and the hole was box-sheeted to prevent movement of the clay.

In this starting pit the first lift or working chamber of the concrete caisson was constructed, 4 ft. high, with a steel cutting edge around the outside perimeter. When this lift had set sufficiently, the inner forms were removed and sinking was started by mucking in the open from the inside, four 15-ton ratchet-jacks being used, with the grillage as a reaction, to force the shell down as rapidly as the soil was removed from the inside. When the top of this lift neared the bottom of the starting pit, a second lift was cast and the sinking resumed until by this process bottom conditions were reached which required a change in method.

At this stage, when the depth under the grillage exceeded 13 ft., steel diaphragm lockheads were set

FIG. 2—DIVER ENTERING CAISSON

and bricked in the shaft, thus making an air lock, and the sinking continued through the quicksand under air, with pressures varying from 10 to 15 lb. per sq.in., until the cutting edge was firm in hardpan.

Where a minimum of 13 ft. was not reached, the caisson was allowed to fill with water to about El. —18, which was two or three feet below the grillage, and a diver was employed to continue the excavation to hardpan. While El. —18 was somewhat lower than the normal level of the groundwater, this head was found sufficient to prevent any boiling of the bottom. The method was necessarily slow and expensive, but it was unquestionably safe. When hardpan was reached the diver removed all overlying material and leveled the area within the cutting edge wherever this was possible

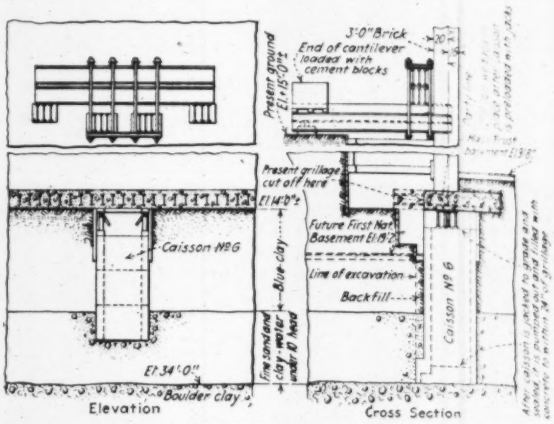



FIG. 3—TYPICAL SECTION OF UNDERPINNING CAISSON

without removing boulders, thus leaving a reasonably smooth surface for bearing.

A concrete seal about 4 ft. thick was then placed. Where air was used for sinking, this concrete was passed through the lock and the pressure maintained long enough for proper set. Where a diver was used, the concrete was passed down to him in heavy canvas bags which he emptied and distributed over the bottom, the normal head of water being maintained until the seal had properly set. The lockheads were now removed or the caisson unwatered, dependent on which method had been used, and the rest of the concreting was done in the open.

After allowing the completed caisson to set three or four days, hydraulic jacks were applied, using the grillage as a reaction, to produce a test load as nearly 25 per cent in excess of the designed load as the confined space and the weight of the reaction would permit. This test load was then caught by inserting short steel struts with top and bottom bearing plates and driving them tight with steel wedges, thus eliminating future settlement as far as possible. As a further precaution, however, the jack load was again applied after a few hours' time and the wedges once more driven tight. The section was then completed by concreting in these struts.

This, the most important underpinning work executed to date in Boston, is now practically complete, with no measurable settlement.

The First National Bank employed Stone & Webster as general contractors, for whom the Chas. R. Gow Co., New England agents of the Raymond Concrete Pile Co., devised the methods used and carried out the work as foundation sub-contractors. York & Sawyer of New York are the architects for the bank, Mr. H. G. Balcom is their consulting engineer. Chas. T. Main is consulting engineer for the Massachusetts Trust Co.

## French Bill Offers Housing Remedy

In order to make it attractive to landlords to rent apartments and dwellings to families wiht children, a bill has been introduced in the French Chamber of Deputies providing for reduced taxation on real estate ranging from 25 to 50 per cent. A 25 per cent reduction is allowed where the ratio of children to the number of apartments is 3 to 1; 40 per cent reduction when the ratio is 4 to 1; and 50 per cent reduction when the ratio is 5 to 1, or higher.

# Initial Failure and Automatic Relief of Stress

## Some Cases of Readjustment of Relations of Parts of Structures Tending to Affect Safety

By David C. Coyle
Structural Engineer, Gunvald Aus Co., New York City

It is a familiar process of thought, among engineers, when the action of a structure under load is obscure or disputed, to picture what would happen in case of complete failure. The imagined deformations of the doubtful members give to the mind's eye an indication of the stresses they are called on to carry. Sometimes we find that a certain member cannot take an exaggerated deformation; should it start to fail, some other part amply strong would come into play and prevent further failure, the weaker part is said to be "fetching up" on the stronger. This idea of the automatic relief of stress is quite simple under some conditions. At other times, however, it may be used unconsciously, concealed under some assumption where it may or may not be applicable, a dangerous process. The purpose of this article is to examine the action of fetching up as it occurs in various everyday cases, so as to bring out the extent and limitations of its usefulness.

There are various plain cases which will serve to illustrate the idea in its simple form. A telegraph key or a swing bridge, starting to deflect under load, fetches up on a rigid support before reaching its elastic limit. A window lintel starting to sag when touched by fire does not fail because the wall fetches up as an arch, and only a few bricks are able to follow the lintel downward. A grillage beam on a hard support, such as concrete or rock, starts to bend under load, but this action throws the pressure toward the center, relieving the ends, and failure in bending cannot proceed.

Whenever we assume that a structure is more determinate than it theoretically is, we are applying the idea of the automatic relief of stress more or less unconsciously, and there is a chance for dangerous error. Let us examine some cases of this kind more in detail.

*Rivet Groups*—A group of rivets is statically indeterminate, since it is theoretically possible for one rivet to take all the load. However, we assume that as the load increases the tightest rivet will start to fail, and the slight motion will bring others into action until enough are working to carry the load. The essential feature which justifies the assumption is that the motion necessary to bring the whole group into action is usually so slight that no rivet is seriously damaged by shearing before the group fetches up as a whole. We therefore avoid very long lines of rivets with the pull applied at one end, because the stretch of the member might shear off the first rivet before stressing the last one, and so rip off the connection.

*Continuous Beam Figured as Simple*—Again, where a structure though actually continuous is figured without regard to continuity, the assumption is implied that the connections can deform without damage sufficiently to permit the members to act as they are figured. For instance, steel girders framing into opposite sides of a column are actually continuous over the support under light loads; but the rivets in the upper part of the connection are usually incapable of carrying the full-load tensile stress across the column. They must therefore start to fail, but before they have pulled apart the girder has deflected and comes into action as a simple beam. The top rivets may be standing under their ultimate tensile stress, but the system has fetched up so that no further stretching occurs and they do not fail.

Sometimes it is necessary to support a smaller steel beam in the middle by a strut down to a heavier beam below. We usually cut the upper beam in two, on the ground that it is improper to figure the two beams as working together, since the strut may be fabricated slightly too long or too short. Yet in the light of our common practice with steelwork it would seem fair to figure both beams as working in proportion to their moments of inertia, since they can take up any initial inaccuracy by a preliminary overstrain and initial failure of one of them. Experience with steel caps in mine timbering indicates that a beam can be bent beyond its elastic limit and yet be practically as strong as before.

*Concrete Beams*—With concrete somewhat different considerations enter. A pair of beams framing into a column cannot be figured as simply supported. Under load they will pull part at the top over the column, and will not, like a riveted connection, remain just as good as new. The crack in the concrete may destroy its shearing strength and cause the beam to fail. On the other hand, in some cases, such as that of a long span next to a short one, the long span may be figured for $w/8$ as a precaution against uneven settlement. A small quantity of steel may be placed over the support to prevent cracking. It is important to note that the purpose of this steel is not to carry a load but to make the concrete act as do the top rivets in a girder connection; i.e., stretch without losing its shearing strength. Most of the authorities, noting that this steel over the support is overstressed, condemn the whole arrangement as unsafe, but the defense, if one wishes to use this system, is that even though stretched beyond its elastic limit the top steel will not pull apart because the beam fetches up as a simple beam.

*Effects of Settlement*—The relation between settlement of footings and the strains in the structure overhead is often very complicated. It is important to have a clear idea of which deformations will limit themselves by fetching up, and which will continue indefinitely and cause a failure.

The difference should be kept in mind between a fluid bearing substance and a compressible one. Pile footings or spread footings in mud are often dependent on friction for support, and as the load is increased they will continue to settle, while in earth or sand the bearing resistance increases rapidly and limits the settlement. In the first case the footing will never fetch up until it strikes hardpan, and the structure must be able to develop within itself the necessary resistance to a permanent unbalanced load.

Where the subsoil is such that an overload footing will ultimately fetch up, the nature of the stresses in the structure may be illuminated by considering the possible automatic relief of stress. An interior column whose footing is too large for it, so that it settles less than those around it, will receive an overload and will shorten; this shortening tends to relieve the overload, except that if the elastic limit has been passed the chances are that there will be enough eccentricity to

start a buckle, seriously weakening the column. The equilibrium between the resisting strength of the column and its load is unstable, in the sense that once it is upset the column fails. A line of beams, on the contrary, may survive a considerable disalignment. When we design a concrete beam for $wl/8$ on the ground that its supports may settle unevenly, we do so only to be on the safe side. Actually the chances are that after an unequal settlement the reinforcing metal will stretch enough to allow the negative steel to come into action if the loads require its help—provided, of course, that the displacements involved are so small that none of the steel has been stretched to necking.

*Local Overstress*—Tests show that in most steel structures there are joints where local stresses are far beyond the working limits. Why are there so few failures? The answer doubtless involves the ductility of steel. A part will carry say 32,000 lb. stress, under conditions which limit its motion under stress. Suppose that in a storm the wind loads, going beyond any it has yet experienced, stress it to 50,000 lb: it stretches and takes a permanent set at the new length and 32,000 lb. stress. The wind stops, its stress drops to 22,000 lb. and will never reach 32,000 lb. again until the big wind is repeated. In this way a properly designed building will gradually adjust itself through the years until it has eased its local stresses somewhat below the elastic limits. It is a similar process that occurs in aging a violin. Failure occurs in a steel structure when there is some local secondary stress (like that in the fatal gusset in the Washington theater) which is in unstable equilibrium; it has nothing to fetch up on except the ground below, and finally finds its resting place there.

*General Principles*—In conclusion one may outline some general principles which apply to the automatic relief of stress. There are two cases, (a) a member starting to fail may fetch up before it is strained beyond its elastic limit, or (b) the member may be strained beyond the elastic limit before it fetches up. For safety the following conditions are necessary:

1. In all cases the body which supplies the needed strength must have a fixed strength of its own. No secure fetching up can occur on mud or any semi-fluid except up to the limit of its capacity in buoyancy.

2. The equilibrium must be stable. Initial failure of the part in question must automatically reduce the load or increase the strength so that the cause of failure is unable to follow the member through to complete collapse.

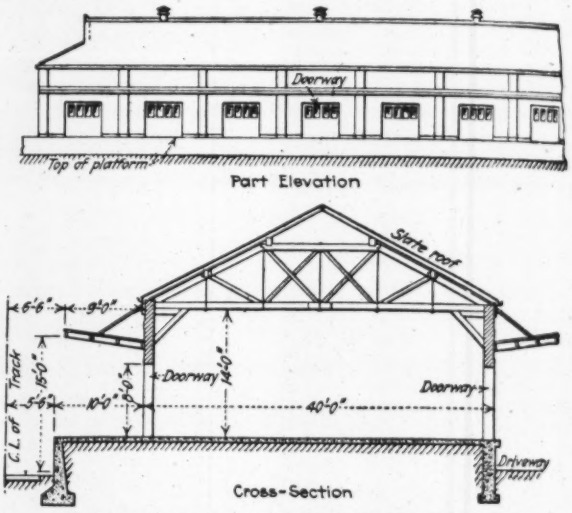
3. If the geometrical arrangement of parts does not prevent the member from being deformed beyond its elastic limit, the member so deformed must be ductile enough to remain practically unhurt in its new shape. For concrete this ductility may be obtained by reinforcement which brings about an even distribution of the stretch.

Under all conditions the vital essential is that if we are neglecting some load or stress because we feel it will be taken care of by the self-adjustment of the structure, we should think clearly and be sure of just what we mean in each case. Our general ideas should represent the sum of definite thoughts, not a mere vague hopefulness that all will be well. The cases cited in the preceding may stimulate clearness of thought in a direction where it is not always evident.

# Improving Daylight Conditions in Railway Freighthouses

## Alternatives of Adequate Daylight Light or Supplementary Electric Light—Roofs, Windows and Skylights

IN ONE-STORY freighthouses of the flat-roof and gable-roof types which are widely used the distribution of daylight lighting is frequently inefficient, since the light enters only at side windows and doorways, the area of which may be obstructed more or less by cars or wagons on the track and driveway sides respectively. Canopy roofs which are placed just above the doorway level, to protect freight when being handled to and from the house, also tend to obstruct the light. Furthermore, the stacking of freight on the floor of the building is likely to interfere with the distribution




TYPICAL SECTION OF RAILWAY FREIGHTHOUSE

or diffusion of interior light from the sides. A typical freighthouse is shown in the accompanying drawing.

Monitor roofs which admit light directly over the middle of the floor have been provided in many cases. But sawtooth or pond-truss roof construction to give increased light has been used very little in buildings of this class, one reason assigned for this being the narrow width of the building, usually 30 to 50 ft. It appears probable that under average conditions freighthouse business is hampered more or less by inadaquate lighting, which may cause delay or inaccuracy in billing and in reading scale weights and the marks and addresses on tags and packages.

Inquiry as to the relation between freighthouse work and freighthouse design in regard to lighting facilities has developed opinions of three classes: (1) The present system which provides only wall openings for interior lighting is satisfactory; (2) This present system is so unsatisfactory that extensive use is made of artificial light during the day, but no steps have been taken toward improving or altering the design in order to give greater daylight efficiency; (3) Some arrangement of roof lighting is employed and is very desirable. There is a rather general objection to skylights on the ground of the chances of leakage and consequent damage to freight.

Opinions expressed on the subject depend largely

upon geographic and climatic conditions. Thus a Canadian engineer considers that a flat roof from which snow will be swept by the wind is decidedly preferable to any irregular shape of roof on which snow might accumulate. An engineer on a large railway system extending mainly through the Southern states is well satisfied with buildings having a solid sloping roof and sidewalls in which the only openings are doorways 8x8 ft. separated by 10-ft. panels of blank wall, as shown in the drawing. The upper half of each door is glazed, but a canopy 9 to 12 ft. wide extends along each side of the house, just over the doorways, thus preventing much direct light from reaching the middle of the floor. The freight scales are placed adjacent to the 10-ft. stretches of solid wall. It is stated, however, that freight is so stacked as to provide passageways for trucking, and that even with the doors closed there is sufficient interior light to permit the work to be carried on without delay.

In other designs there are side windows alternating with the doorways, while some modern freighthouses have both sides composed entirely of sliding doors which form the panels between the columns supporting the roof. In some cases also a line of shallow windows is placed above the doorways, an arrangement which should improve the interior lighting materially. In general the lighting requirements are similar to those of factory and industrial buildings, but as a rule these later buildings are wider than freighthouses and have a much larger area of window space, while one-story manufacturing buildings usually have some provision for lighing through the roof. Nevertheless, the present tendency in the design of such buildings is to increase the window area, even to the extent of using curtain walls composed almost entirely of glass.

Present unsatisfactory conditions in the lighting of freighthouses together with the possibility of improvement in these conditions, were noted in *Engineering News-Record* of March 9, 1922, p. 393. This article showed that even in a freighthouse 35 ft. wide and having a monitor roof the lighting was inefficient, leaving many dark or gloomy areas. By means of larger windows the glazed area was increased 260 per cent. Much depends upon environment and maintenance. As to environment, a lighting area which is ample for a freighthouse in a country town may prove quite inadequate for a city building in a smoky atmosphere and surrounded by tall buildings. As to maintenance, the lighting efficiency will be higher where the walls are whitewashed or painted a light color and where the walls and windows are kept clean. Freight should not be stacked close to walls and windows, a broad passageway being kept clear along the sides of the building.

Reference has been made to the daylight use of electric light in freighthouses. In advocacy of this practice it has been urged that electric light is now so cheap as to warrant its use in this way in order to facilitate the work of the freighthouse, thus effecting some economy in operation. For such industrial lighting it is essential to provide lamps of proper type, position and spacing in order to give a general diffusion of light and to avoid alternations of light patches and deep shadows. For the interior electric lighting of freighthouses the following recommendation is made in a bulletin on "Modern Practice in Railroad Lighting," issued by the National Lamp Works, Cleveland, Ohio:

"A direct lighting system should be installed which should provide an intensity of from three to six foot-candles. Reflectors should be used and they should be mounted high enough to insure sufficient intensity in the vertical plane to enable package markings to be easily read."

But even if artificial lighting is cheap, daylight is cheaper, and it seems evident that in many cases it is practicable to improve daylighting conditions very materially. Two points may be noted as calling for consideration in the design of new freighthouses and the improvement of existing freighthouses: (1) Can adequate daylight lighting be provided for economic operation of the business under average conditions, leaving electric light for use on dark days and for night work; (2) if electric light is considered essential to supplement daylight in regular day work, how can it be arranged so as best to combine economy and efficiency.

## Municipal Waste Disposal in Iowa

IOWA, a state of small towns, has comparatively few municipally-owned garbage and waste disposal systems. While the problem is essentially engineering, little attention is paid to it by municipal engineers according to Earle L. Waterman, associate professor of sanitary engineering, State University of Iowa, in a paper presented recently to the Iowa Engineering Society. Information from cities of more than 7,000 population was given, mostly obtained from the city clerks. The costs per capita shown in the table are computed on the basis of the 1921 expenditures and population of the 1920 census.

In thirteen of the largest cities, all over 16,000, the collection is done by city employees or by a contractor for the city. In only one city of less than 16,000 population is the collection handled as a community problem.

As to area covered by the collection system the replies to a questionnaire were as follows: Des Moines, less than one-half but all of the thickly settled portions; Sioux City and Cedar Rapids, 75 per cent; Clinton, 66 per cent; Waterloo, Council Bluffs, Burlington, Ottumwa and Mason City practically the whole area.

Professor Waterman noted the following with reference to methods of disposal:

*Feeding to Hogs*—In most instances where the municipal garbage is fed to hogs the hogs are owned by private parties who are either contractors collecting the garbage or individuals who receive it from the collectors. In Waterloo and Fort Dodge private companies collect the garbage and use it for hog-feeding. Sioux City is the only municipality in the list which owns its own hogs and hog farm.

*Sanitary Fill*—In some Iowa cities, both garbage and refuse are used for filling in low land. This method is economical and satisfactory where it is properly done, but a cause of many complaints when it is not carefully planned and executed. It is reported as being satisfactory at Davenport where low land along the Mississippi River is being reclaimed. Here piles of ashes and dirt are spaced along the top of the embankment so that there is just room for the garbage wagons to back in between the piles and discharge their load of garbage on the face of the bank. As soon as the wagon is pulled out, men with long handled shovels cover the garbage with 8 to 10 in. of earth and ashes. Approximately 2 cu.yd. of covering are required for each 1½ cu.yd. of garbage. It is occasionally necessary to obtain cover material from outside sources.

*Incineration*—In Council Bluffs, Mason City and Ottumwa incinerators are used for the disposal of municipal wastes. This method has also been used in Des Moines but it is reported that "the operation of the incinerator has been

abandoned because of excessive costs." Cost of operation as reported for Mason City and Ottumwa do not appear to be excessive. In Council Bluffs the service is paid for by the people for whom rendered and not by a tax levy as is the case at Mason City and Ottumwa. The city clerk at Council Bluffs states that the incinerator in that city has been in operation for several years and that as far as the garbage problem is concerned they consider that it is satisfactorily solved. The state sanitary engineer makes the following comment on the Council Bluffs incinerator: "All the garbage and refuse, except ashes and tins, is hauled to an incinerator and burned. From 65 to 75 lb. of coal is used per ton of garbage and the officials have no trouble. The incinerator is located near the residential district and it is so clean and so free form odor that you would not know it was there unless you saw it."

TABLE I—COSTS AND METHODS OF MUNICIPAL REFUSE DISPOSAL IN IOWA CITIES

| City | 1920 Pop. | Collection By | Wastes Collected | Method of Disposal: Garbage | Refuse | Ashes | Costs per Capita for 1921 | Paid By |
|---|---|---|---|---|---|---|---|---|
| Des Moines | 126,468 | City | Garbage | Burn on dump | ..... | ..... | $0.54 | Tax |
| Sioux City | 71,227 | City | All | Hogs | Dump | Dump | .71 | Tax |
| Davenport | 56,727 | City | All | Sanitary Fill | | | ..... | ..... |
| Cedar Rapids | 45,566 | City | Garbage and refuse | Sanitary Fill | | | .38 | Tax |
| Dubuque | 39,141 | Contract | All | Dump | Dump | Dump | ..... | Tax |
| Waterloo | 36,230 | Contract | All | Hogs | Dump | Dump | .60 | Tax |
| Council Bluffs | 36,162 | City | Garbage and refuse | Incinerator | ..... | ..... | ..... | Indiv. |
| Clinton | 24,151 | City | Garbage | San. Fill | ..... | ..... | * .13 | Tax |
| Burlington | 24,057 | Contract | Garbage | Buried | ..... | ..... | † .29 | Tax |
| Ottumwa | 23,003 | City | Garbage and refuse | Incinerator | | Fill | .35 | Tax |
| Mason City | 20,065 | City | Garbage | Incinerator | ..... | ..... | .35 | Tax |
| Ft. Dodge | 19,347 | Priv. Col. | Garbage and refuse | Hogs | Dump | ..... | ..... | Indiv. |
| Muscatine | 16,068 | City and Contract | All | Hogs | San. Fill | | † .26 | Tax |
| Keokuk | 14,423 | Private collection | Garbage | Hogs | ..... | ..... | ..... | ..... |
| Boone | 12,451 | Private collection | Garbage | ..... | ..... | ..... | ..... | Indiv. |
| Iowa City | 11,267 | Contract | Garbage | Hogs | ..... | ..... | .14 | Tax |
| Oskaloosa | 9,427 | Private collection | Garbage | Hogs | ..... | ..... | ..... | Indiv. |
| Creston | 8,034 | Private collection | Garbage | ..... | ..... | ..... | ..... | Indiv. |

* Five months. † Six months.

## Wharf Construction Details to Protect Against Marine Borers

ADDITIONAL details concerning wharf construction to protect against marine borer depredations were given in the report of the wharf construction section of the San Francisco Bay Marine Piling Committee at the recent meeting of the American Wood Preservers Association. Last year's recommendations (see *Engineering News-Record*, March 2, 1922, p. 358) have been widely approved but the following points have been added by a special subcommittee, W. H. Kirkbride, engineer maintenance of way and structures, Southern Pacific Co., and Ralph A. Beebee, city harbor engineer, Oakland.

*Bracing*—Wharf structures built on creosoted piling should not be braced by means of lateral braces or any method which requires framing below the high tide line. Batter piles having their connections above high tide line, form a satisfactory method of bracing such structures.

*Fender Lines*—Full length fender piles should be creosoted to increase their life against marine borers and be protected from the mechanical wear which ordinarily limits their life. This protection can be satisfactorily accomplished by using untreated stubs, spaced alternately with the fender piles and set out so as to absorb the shock from ships. For California ports Eucalyptus is available and might be suitable for fender stubs, since it has the necessary hardness and toughness. It is already being used to some extent for this purpose by the Board of State Harbor Commissioners.

The flooring system, by its importance, deserves more attention than has previously been given to it. The following recommendations are devoted to that phase.

*Cutoffs, Corbels and Caps*—The recommendations of last year for placing these above high tide level and for painting them with hot creosote where the latter is not possible, are heartily concurred in. For corbels and caps a light pressure treatment of 6 lb. of creosote per cubic foot, previous to placement in the structure, is recommended.

*Timbers for Flooring Systems* should in all cases be as heavy as can be used within economical cost. It should also be given a light creosote treatment (6 lb.) after it has been framed, etc., whenever that is possible. This recommendation of framing (including bolt holes) before treatment, is the one most often objected to as impracticable, impossible or too costly. Actual and continued trial has proved it practicable on most ordinary simple construction on San Francisco Bay, where, except for one company, all creosoting must be obtained from a long distance. In ordinarily simple construction bents can usually be sprung enough to make such framing fit. This procedure adds somewhat to the construction cost, but its results are believed to justify its cost. The recommendations of last year's report in respect to boring drift bolt holes the same size as the bolts should hold for floor system timbers, as well as for bracing, etc.; where machine bolts are used, however, the holes should be bored $\frac{1}{8}$ in. larger than the diameter of the bolt. Holes which must be bored in timbers after they are treated should be filled with hot creosote, if possible, before the bolt is inserted. Deck planking can be spiked to creosoted stringers without damaging the creosote protection if care is taken that the creosoted timber is not split by the spiking.

If it is not desired to use creosoted timber for the floor system in a deck, care should be used to ventilate contact surfaces or to give them as thorough a treatment with creosote as possible. Hot creosote swabbed on plentifully during construction is the best treatment available under such circumstances.

It is very desirable to place a watertight covering, such as a 2-in. surface coating of asphalt, over the deck of wharf structures. Such a coating makes a satisfactory floor surface, gives additional fire protection and keeps surface water from seeping into the wooden floor system.

## London's Rapid Transit Traffic

Rapid transit traffic on five of the electric underground and suburban surface lines of London, but exclusive of the electric street railways, amounted to 325,000,000 in 1922 as compared with 329,000,000 in 1921, but this loss was more than made good by an increase of 85,000,000 in the number of passengers carried by omnibuses. These figures were given at a joint meeting of the Metropolitan District Railway Co., London Electric Railway Co., Central London Railway Co., City & South London Railway Co. and London General Omnibus Co. The decline in local railway traffic was attributed to the general depression, while the growth of omnibus traffic was attributed to the increased number of large modern omnibuses. To help in solving the problem of unemployment, arrangements were made in 1922 to build certain extensions and to enlarge the tunnels of the City & South London Ry. so as to accommodate the rolling stock of other underground lines. These works are now well advanced.

# Letters to the Editor

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## More Machinery, Not More Immigration, Seen as Country's Need

Sir: There are those who advocate letting down the bars on immigration while discussing the recent Immigration Bill which failed of passage. The basis of argument used is that it is necessary to obtain cheap labor.

That cheap labor is one necessity for our return to normalcy is admitted, but it would appear that there are several disadvantages connected with the method advocated for obtaining it.

On the basis of the experience of this country from 1914 on, I believe the results have shown that it is absolutely desirable to put the bars higher than ever on immigration, if we are to retain the distinctive characteristics which made us the nation we are and not become submerged by undesirable European hordes. In all our great cities today we have the foreign quarters with high percentages of illiteracy and inability to read anything which might tend to Americanize them or convey American ideals to the newcomers. They have their own newspapers, they think and understand only those things which it is absolutely necessary they understand—as,, for instance, our money system and a few other things. It is unnecessary to point out the dangers of having vast numbers of unassimilated people in our midst who can be controlled for good or evil by an individual of a mentality only slightly in advance of their own mentalities.

Furthermore, the type of immigrant we are obtaining today is not to be compared with the type we formerly received. The European countries themselves are not so foolish as to let their most desirable citizens emigrate. Furthermore, the preponderance of immigration today comes from the southern European nations, and is not nearly so desirable as that of the northern European countries (including the Scandinavian). The latter are assets to this nation or become so within a few years. The former gather together in their cliques and remain "sores" in our large American cities. In some of our cities, one could walk for miles and wonder whether he were in Europe or America, the particular part of Europe being determined from the particular foreign quarter. What is needed first in this country, today, is to digest thoroughly the immigrants we have already received and to change them from liabilities into assets. Glance over the nationality of the names of those interested in the I.W.W., bolshevik, communistic and allied movements, and the proof of the above argument will be evident. Allow me to invite your attention to one of your contemporary magazines, *Industrial Management* for November, 1922, which states that "the crude labor shortage argument makes a plausible peg on which to hang price increases in steel, and on which to combat decreased freight charges. A preponderance of crude labor, like a preponderance of wheelbarrows, shovels, and other inefficient and primitive tools in a modern factory is an admission of managerial inferiority. It is an acknowledgment of inability to cope with the industrial situation with the God-given weapon of invention. . . . The sooner our big industries become aware that there there is to be a perpetular shortage of unskilled labor, the sooner our inventors will get to work and devise mechanisms that will do the work many times better and faster. Machinery and not immigration is the answer."

R. E. BASSLER,
Lieut., Civil Engineer Corps,
U. S. Navy.

Washington, D. C.
March 13, 1923.

## Direct Oxidation Official Comments on Mr. Potts' Letter to Gov. Silzer

Sir—On p. 507 of your issue of March 15 appears a letter addressed to Governor Silzer of New Jersey by Clyde Potts, in which, in reply to my charge against him, which I am prepared to sustain, he brings up the old Phillipsburg indictment, with the idea that it will reflect discredit upon me.

Mr. Potts well knows that no responsible person has ever imputed to me any personal culpability in this matter. The indictments were instigated by a business competitor of a sub-contractor and are based on the foolish assumption that all work done on or near the site of the plant should have been done under the contract, and that some extra grading, a retaining wall, etc., not even contemplated when the contract was let, were improperly allowed as extras.

No official of Phillipsburg had any part in the bringing of these indictments, and the Direct Oxidation Disposal Corporation is now operating the plant under a monthly contract.

My sole connection with the matter was that the orders of the town engineer for extra work passed over my desk as president of the Municipal Disposal Co., which had the general contract, on their way to the sub-contractor, who did the work and got the money. I had no choice in the matter as under the terms of the contract the authority of the town engineer to order extra work was absolute.

Mr. Potts' insinuation thus comes with bad grace, and is quite obviously designed to divert attention from himself at a critical time.

It is perhaps needless to say that the Direct Oxidation Disposal Corporation, as well as myself, would welcome any investigation which Governor Silzer or any other responsible person may desire to make. Such investigation would reveal only that the company is a reputable and responsible business organization, which has a pardonable reluctance to be made the victim of the private revenge of a public official.

Philadelphia, March 22. H. JEROME HIRST.

[A synopsis of the indictment mentioned and of preceding events appeared in *Engineering News-Record*, April 27, 1922, p. 710.—EDITOR.]

## Rock Borers in Concrete Exaggerated

Sir—Under the caption "Rock Boring Mollusks Attack Concrete Pile Jackets," *Engineering News-Record*, March 15, 1923, p. 499, publishes a report by biologists of the San Francisco Bay Marine Piling Committee on the discovery of boring mollusks in so-called concrete pile jackets of Los Angeles Harbor.

The writer protests the term "concrete" used in describing the material in which these borers were found, and also takes exception to the inferences drawn in the latter portion of the report as being premature and not warranted by the data or information now at hand.

Specimens of the jackets penetrated were submitted to the laboratory of the Board of State Harbor Commissioners for inspection and analysis. None of the specimens submitted was "concrete"; all were inferior grades of cement mortar made up of a beach sand so fine that approximately 93 per cent passed the 50 mesh screen. The poorer specimens were little better than laitance and sand and were about as hard as chalk. The best specimen was selected for testing and gave a crushing strength of 1,726 lb. per square inch. The accompanying photograph of the fracture not only shows the excessively fine grading of the aggregate, but also the variable distribution of cement through the aggregate. The report calls this material a "medium grade of mortar concrete" and states that "service in sea water over a period of fourteen years indicates a composition as good as that of much of the concrete used for such purposes." Our laboratory analysis and test indicates a material such as no engineer would employ as concrete anywhere, and particularly not in sea water exposed structures. The fact that material of this nature gave service for fourteen years is only indicative of the indefinitely longer life of real concrete properly proportioned and placed.

A search was made for pholad borers in the concretes of San Francisco Harbor, some of which have given service without appreciable deterioration for thirty years. Piles jacketed by setting forms in the water similarly to the Los Angeles pile coatings were pulled and carefully inspected without evidence of borer attack being found. Some of these piles were located at the inner end of the Golden Gate within a mile of locations where rock borers are known to exist in rock suitable for their habitat. The inference would seem to be not that the concretes of the harbor had not been exposed, but that the rock aggregates used in these concretes as contrasted with the extremely fine

FINE GRAINED "CONCRETE" WHICH BORERS ATTACKED

aggregates in which the borers were found, do not constitute a desirable habitat for rock borers. At any rate if over a period of thirty years, the pholad borers of the Golden Gate have not been tempted to seek new quarters in concrete structures, future attack is improbable.

These borers appear to favor sedimentary rocks such as shales and calcareous sand stones, some of which are harder than the mortar in which they were found at Los Angeles, but many of which tend to weather and soften on exposure to sea water. The mortar in which they were found was itself of such quality that softening in sea water would ordinarily be expected and the relation of sea water disintegration to the borer attack should be considered. No borers have been reported in igneous or metamorphic rocks which are suitable for aggregate in concretes exposed to sea water, and it is extremely doubtful if borers could enter the interstices between the aggregate in dense concrete required for resisting sea water disintegration.

For this reason it would seem that the occurrence of borers in low grade cement mortar is more interesting from the biological view point than it is alarming from the engineering view point. Marine concrete structures are in little danger of being riddled by pholads and the concluding speculation of the report is unwarranted especially in a scientific report. Engineers will do well to concentrate their efforts on meeting the more pressing problems of sea water exposed concrete construction: the problems of protecting reinforcing steel and of producing non-absorbent concrete. In doing this they will indirectly solve such problems as might arise from the possible attack of rock-boring mollusks.

HARRY EDWIN SQUIRE,
Asst. Harbor Engineer.

San Francisco, Calif., March 21, 1923.

## Winter Track Work: Pere Marquette Ry.

Sir—I read with interest your article in *Engineering News-Record* of March 8 on "Development in Railway Maintenance-of-Way Methods." Under the heading "Permanent Section Forces" I note that one road in a cold and mountainous district considered it would be practical to find work for section forces throughout the winter and that one road in the eastern, one in the central and one in the northwest district use the minimum permanent gangs the year round. I note also that twenty-four railroads approve of the system of permanent forces and that fourteen are using it.

This winter we have, for the first time, carried extra gangs on our road, allowing them to lay rail when the weather permitted. The most of this work, fortunately, was under contract, where the railroad did not suffer by reason of short hours put in. I have personally been a strong believer in reducing the forces to a minimum when the fall work was cleaned up and only carry over through the winter the actual forces needed to take care of track shimming and inspection and the small work incident to keeping the track in order through the winter. I have felt the same in connection with our bridge gangs; that the work accomplished in the winter is small and that the risk of accident is great. I am basing my views upon my experience. I realize that the man problem is quite different now and it may be necessary for me to change my views.

FRANK H. ALFRED,
President and General Manager
Pere Marquette Ry.

Detroit, Mich.
March 16, 1923.

## Announce Bidding Prices for Building Work When Award Is Made

Sir—Attention is invited to a growing practice in building contracting that merits comment.

There was a time when a bidder was considered to be entitled to know what were the figures of his competitors—this in the spirit of fair competition. This custom seems to have fallen into disuse, except in the award of public contracts. Architects make awards without even the courtesy of notice to bidders that contracts have been closed, and many corporate interests, acting through their employees, do likewise. What can be the reason for shrouding the bids in mystery?

The preparation of a bid, the sum of which runs into hundreds of thousands of dollars, calls for some expense and certainly entitles the maker to know at least the figure of the successful bidder.

Few reputable architects will enter an open competition. In this connection the writer recalls an experience while practicing architecture some ten years ago. After a considerable outlay in preparation of plans, a postal card was received; I give you the wording: "What do you want done with your plans?"

I recently prepared a bid for work amounting to over $350,000. The cost of preparation, I figure at about $300. Notice that award has been made—a most extraordinary thing these days—has reached me, but why omit the amount of the award?

It is my belief, after many talks with prominent builders that unless the game is to be played above, rather than under the table, the invested capital in building contracting will be placed elsewhere. No one will risk his money in such a perilous business.

New York, March 24, 1923. CLARENCE S. HOWELL.

## Small Sewage Works for New Prague, Minn.

An Imhoff tank of 80,000 gal. capacity of the return-flow type and also a shed-covered sludge drying bed have been built for New Prague, Minn. The cost of the tank, sludge drying bed, sludge pumps and motor, piping, outfall sewer and all accessories was $10,489.

# News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

## News Brevities

**The City Manager Plan** was recently adopted by Knoxville, Tenn., the popular vote being 3,774 for to 1,861 against.

**Formal Decision** of the Indiana Engineering Society to enter the Federated American Engineering Societies has been announced by the president, W. H. Elliott, city engineer of Indianapolis.

**Warrenton, Ore., Has Chosen** a business woman, Mrs. R. E. Barrett, as city manager. Mrs. Barrett, who is prominent in real estate and development work on the Coast, was chosen from a list of 20 applicants.

**During the Spring Meeting** of the American Society of Mechanical Engineers which is to be held in Montreal, Quebec, May 28-31, a special railroad session has been arranged for the morning of May 29. Two interesting papers, one on modern methods of car construction and the other on railroad motor cars, have been prepared.

**By the Annual Financial Statement** of the Canadian Pacific Ry. gross earnings of $186,675,035 and working expenses including taxes amounting to $150,373,344 are shown. Deducting fixed charges of $13,348,905 left a surplus of $22,952,785. Gross earnings were less than those of 1921 by $6,346,818, but net earnings showed an increase of $2,099,950.

**During the Week** May 14-20 commercial associations and trade organizations in New York City and State will unite in an effort to make known to all citizens benefits to be derived by the use of arbitration in settlement of business differences. The week is to be known as "arbitration education week," and the drive is being fostered by the Arbitration Society of America.

**Application Has Been Made** by the Central Pacific Railway Co. for a certificate of public convenience and necessity for authority to construct a 118-mile link from near Kirk, in Klamath County, Ore., to Oak Ridge, in Lane County. The purpose of the new line will be to develop timber and agricultural resources and to provide direct railroad connection to the Willamette valley and Portland.

**The Bill to Create** the Kennebec Reservoir Co., which sought to construct an immense storage reservoir in the Dead River region for the purpose of regulating water supply to mills on the Kennebec River, was vetoed by Governor Baxter of Maine last week. Governor Baxter said in a special message to the Legislature that such a potential water supply should be retained by the state until the people of the state are given an opportunity to decide whether it shall be developed by them in their interests.

## Road Construction Contracts in California May Be Cancelled

In accordance with a policy of economy and retrenchment inaugurated by the new Governor of California, the Highway Commission proposed to cancel contracts on several jobs not considered by the newly appointed Highway Commission as necessary parts of the main trunk highway. Before any action was taken on this plan, however, legal advisers of the State pointed out objections. Question is raised, for example, as to the legality of taking funds voted for road building with which to pay contractors for losses on abruptly terminated contracts. Meantime work is progressing on the contracts in question.

## Double Tracking for Santa Fe Ry.

An extensive work now in progress on the Atchison, Topeka & Santa Fe. Ry. is the double tracking of its main line from Albuquerque, N. M., to Barstow, Calif., a distance of about 750 miles, thus greatly reducing the amount of single track between Chicago and San Francisco. Some sections of the work are already under construction. This improvement has been adopted in order to increase the traffic capacity on a line through rough country and having relatively heavy grades which affect operation. East of Winslow the easier grades permit of heavier trains so that the traffic capacity of single-track is greater. Grade reduction is included in the improvement; in some cases by building a double-track relocation and in others by building the second track on a new location. The maximum grade on this 750-mile district will be 1.42 per cent, as against 1.82 per cent at present.

This work is under the direction of C. F. W. Felt, chief engineer of the Atchison, Topeka & Santa Fe Railway System and R. B. Ball, chief engineer of the Pacific Coast lines (A., T. & S. F. Ry.)

## Paving Brick Committee Acts on Varieties

### Annual Meeting of Simplification Committee Co-operating with Department of Commerce

As reported in the last issue of *Engineering News-Record*, the Standing Committee on Simplification of Varieties of Paving Brick, which is co-operating with the Department of Commerce, at its meeting in Washington, March 27, eliminated from the "recognized" types and sizes the repressed hillside brick, 4 x 3¼ x 8¼ in.

As a basis of this year's deliberations the committee had at its disposal a survey of the production of brick in 1922, made at the request of the Department of Commerce by the National Paving Brick Manufacturers Association. The report showed a total shipment in 1922 of 419,640,000 brick. Of this total 352,000,000 brick or 84 per cent were of the seven "recognized" types and sizes adopted by the Standing Committee, March 27, 1922. The remaining volume was distributed between more than 35 varieties.

The following table shows the shipments and the percentage which each variety bears to the total shipments.

The committee eliminated as a "recognized" variety the repressed hillside brick, 4 x 3¼ x 8¼ in., because it regarded this variety as, essentially, a special brick, and because the shipments had amounted to only 4.1 per cent of the total.

The two wire-cut-lug brick varieties, 3 x 3¼ x 8¼ in. and 3¼ x 3¼ x 8¼ in., representing 2.1 per cent each of the total shipments, were retained after discussion. It was pointed out that these sizes are much used in the Southern States.

A suggestion that the vertical fibre lug brick, 3 x 4 x 8¼ in., constituting 5.1 per cent of the total shipments, be designated a "recognized" variety failed to receive the approval of the committee, it being the consensus of opinion

SHIPMENTS IN 1922 OF SEVEN RECOGNIZED VARIETIES AND FOUR ELIMINATED VARIETIES OF PAVING BRICK. (TOTAL SHIPMENTS FOR YEAR, 419,640,000)

| | No. | Per Cent |
|---|---|---|
| **SEVEN RECOGNIZED VARIETIES** (Adopted by the Committee, March 27, 1922.) | | |
| Plain wire-cut brick (vertical fibre lugless) | | |
| 3 x 4 x 8¼ in. | 145,221,623 | 34.4 |
| 3¼ x 4 x 8¼ in. | 48,010,783 | 11.5 |
| Repressed lug brick | | |
| 4 x 3¼ x 8¼ in. | 82,362,675 | 19.6 |
| Wire-cut lug brick (Dunn) | | |
| 3 x 3¼ x 8¼ in. | 8,804,440 | 2.1 |
| 3¼ x 3¼ x 8¼ in. | 8,707,359 | 2.1 |
| 4 x 3¼ x 8¼ in. | 42,738,399 | 10.2 |
| Hillside brick (repressed) | | |
| 4 x 3¼ x 8¼ in. | 16,681,375 | 4.1 |
| Total (seven recognized varieties) | 352,526,654 | 84.0 |
| **FOUR VARIETIES ELIMINATED** (By Committee, March 27, 1922) | | |
| Repressed lug brick | | |
| 3¼ x 3¼ x 8¼ in. | 7,552,755 | 1.8 |
| Vertical fibre lug brick | | |
| 3 x 4 x 8¼ in. | 21,038,699 | 5.1 |
| 3¼ x 4 x 8¼ in. | 2,417,865 | 0.6 |
| Hillside brick (Dunn) | | |
| 4 x 3¼ x 8¼ in. | 1,821,630 | 0.4 |
| Total (four varieties eliminated) | 32,830,949 | 7.9 |

that the use of this variety is local and that it is undesirable to encourage its spread nationally.

Frank B. Dunn, of the Dunn Wire-Cut Lug Brick Co., had requested the committee to restore as a "recognized" variety wire-cut lug hillside brick, 4 x 3½ x 8½ in. This variety constituted only 0.4 per cent of the shipments for the year and the restoration vote was lost due to its failure to receive the unanimous vote, which is necessary for the designation of a "recognized" variety.

The committee then re-affirmed its action of March 27, 1922 and designated as "recognized" varieties the first six bricks in the preceding table. For the current year, therefore, there are only six "recognized" varieties instead of seven as heretofore.

The committee decided to request the American Engineering Standards Committee to arrange for an investigation of the service rendered by different types of paving brick. This resolution was carried after it was brought out that engineers desire to know the merits of different types of paving brick and especially the relative merits of the lug and lugless types.

The committee voted to hold its next meeting in March, 1924. The members of the committee and the organizations they represent are as follows: P. H. Bates, Bureau of Standards; Will P. Blair, American Society for Testing Materials; R. Keith Compton, American Society of Civil Engineers; E. E. Duff, Jr., National Paving Brick Manufacturers Association; W. A. Durgin, Department of Commerce; G. F. Fisk, American Society for Municipal Improvements; L. C. Herrick, American Association of State Highway Officials (absent); E. W. McCullough, U. S. Chamber of Commerce; E. J. Mehren, *Engineering News-Record* (Chairman); O. W. Renkert, American Ceramic Society; P. St.J. Wilson, Bureau of Public Roads.

## Fatal Collapse During Demolition of Building

One workman was killed and many others injured in the collapse of several floors of a building in course of demolition at 39 Eldridge St., New York City, on March 30. Material accumulated on one of the floors overloaded it so that it broke when temporary shores under the joists were removed, and fell through two floors below to the cellar.

## Pennsylvania R.R. Distributes $67,921,961.37 in Relief

The report for 1922 of the voluntary relief department of the Pennsylvania R.R. system, which has just been compiled, shows that during 1922 $3,639,131.90 was received in benefits by employees and their families. Since the relief plan was inaugurated, 37 years ago, the benefits received have totaled $67,921,961.37.

Extra allowances paid last year to pensioned employees who were members of the fund at the time of their retirement, amounted to $443,274.91. Altogether, since the establishment of the plan, $2,988,386.21 has been distributed in this way.

The companies comprising the Pennsylvania Railroad System contribute the entire cost of operating the Relief Department, which in 1922 amounted to $825,411.64.

## Index Ready April 15

**Numerous inquiries received as to when the consolidated index of 1917-1922 would be issued, leads *Engineering News-Record* to make the announcement that the index is yet in the printer's hands. It is hoped the first copies will be ready for distribution by April 15. Copies will be sent out according to priority of receipt of the order.**

## Baltimore Chosen for Conference on City Planning

Baltimore has been chosen as the meeting place for the fifteenth National Conference on City Planning and the date has been fixed as Apr. 30 to May 2. The headquarters will be in the Hotel Southern. The Baltimore Zoning Commission will place on exhibit what is described as "a remarkable set of maps and data on existing structures" and a variety of city planning information. The main subjects for discussion at the conference will be regional planning, inter- and intra-urban transit and traffic, zoning, water supply, park systems, port development, automobile parking, and the major street system. Joseph W. Shirley, City Hall, Baltimore, is chairman of the Baltimore committee in charge of the conference, and J. C. Grinnalds, City Hall, Baltimore, is assistant chairman. A detailed program of the conference may be obtained from Flavell Shurtleff, secretary, 130 E. 22nd St., New York City.

## North Carolina Authorizes $15,000,000 for Roads

The North Carolina State legislature now in session has authorized an additional bond issue of $15,000,000 to be used by the state highway commission for the construction of roads and bridges. This, together with the $50,000,000 authorized by the 1921 legislature, makes available $65,000,000 for the construction of the state highway system. To this sum may be added the state's federal aid from the U. S. Bureau of Public Roads.

A feature of the new act provides a tax of 3 cents per gallon on gasoline and other motor vehicle fuels to take care of the interest on bonds, sinking fund, etc. The remainder, together with the proceeds of the motor vehicle licenses is to be used for maintenance purposes. This last sum will amount to around $5,500,000.

## Motor Vehicle Registration Gains

In 1922 motor vehicle registrations more than maintained the rate of rapid increase which has caused the total registration to grow from 3,500,000 in 1916 to 12,238,375 motor cars and trucks at the end of 1922, according to the U. S. Bureau of Public Roads. Last year the increase amounted to 1,775,080 registrations as compared with an average yearly rate of approximately 1,390,000 for the preceding 5 years.

The total gross registration revenue amounted $152,047,823, of which $117,093,116 was applied to road work under the supervision of the state highway departments. Eighteen states taxed gasoline, deriving a revenue of $11,923,442, not all of the states reporting for a full twelve-month period.

## Last Word in F. A. E. S. Expenditures

Answering the charge made by Richard L. Humphrey and Arthur P. Davis in *Engineering News-Record*, March 29, 1923, p. 599, that he misstated the traveling expenses of the Federated American Engineering Societies in 1922, C. M. Holland has written to Messrs. Humphrey and Davis a letter which includes the following:

"In answer to your statement, I submit the following which is an exact copy of Secretary Wallace's financial statement, showing the expenditure for travel for the year 1922 was $8,417.65, as stated in my communication to Gardner S. Williams [See *Eng. News-Record*, March 1, 1923, p. 412.—Ed.]

STATEMENT OF EXPENDITURES FOR TRAVEL BY THE FEDERATED AMERICAN ENGINEERING SOCIETIES

January 1, 1922, to January 1, 1923

| | |
|---|---|
| Members of Executive Board | $3,936.16 |
| Representatives on National Board Jurisdictional Awards | 153.39 |
| Members of Committee on Procedure | 272.28 |
| Publicity Director Attendance Upon Meetings of Executive Board and Council | 309.18 |
| Executive Secretary and Members of Staff | 1,983.25 |
| Members of American Engineering Council | 1,763.26 |
| Total | $8,417.65 |

(Signed) L. W. WALLACE,
Executive Secretary.

"I think that the above completely answers your criticism and shows that my statement was correct."

The figure given by Messrs. Humphrey and Davis was $7,682.70. It will be noted that this is the sum of the first, fifth and sixth items in the above tabulation.

## Fabricators' Committee Recommends Higher Steel Stresses

A board of engineers retained by the American Institute of Steel Construction, an organization of steel fabrication concerns, to report on the subject of working stresses for steel framework of buildings has just reported in favor of a basic stress of 18,000 lb. per sq.in. This recommendation, however, is restricted to steel of bridge grade in place of the generally used building grade, which latter is of lower strength. Other specifications for material methods of design and workmanship were also fixed by the board in its report. It is expected that the specification will shortly be published. The board consisted of Prof. George F. Swain, Prof. M. S. Ketchum, E. R. Graham, W. J. Watson and W. J. Thomas. A similar recommendation for raising the present 16,000 lb. working stress in building practice to 18,000 lb. was made two years ago by another fabricators' organization.

## Glens Falls Dam Closed

The large power reinforced-concrete dam built for the International Paper Co. across the Hudson River at Sherman Island, just above Glens Falls, N. Y., was finally closed on March 29, before the usual spring rise in the river. The dam holds back about 50 ft. of water and is part of a hydro-electric development now nearing completion under the Parklap Construction Co., New York City.

# Water-Works Operators Meet at Decatur, Ill.

### Many Varied Topics Consume Discussion at State Section Meeting

Local financing of water-works by customer ownership, water softening status, the fuel problem, electrolysis, meter and filtration difficulties were the principal topics of discussion March 21 and 22 at the meeting in Decatur of the Illinois section of the American Water Works Association.

For the first time in many years optimistic financial statements emanated from the operators of privately-owned systems. They have discovered that their own customers have money and are willing to put it into the local water business. F. C. Ambary, manager of the Champaign and Urbana Water Co., outlined a successful sale of 7 per cent preferred stock to the home folks. Wilson M. Bering, secretary of the Decatur Water Supply Co., detailed the procedure of selling more than a million dollars worth of preferred stock to citizens of Decatur for the purpose of acquiring an impounding storage reservoir financially beyond the debt limit of the city. (See *Engineering News-Record*, Feb. 16, 1921, p. 299). Preferred stock is to be retired by a sinking fund leaving the plant to the city which owns the common stock. H. E. Jordan, Indianapolis Water Co., stated in discussion that their 7 per cent preferred stock was being refunded by 5½ per cent bonds at 95. W. S. Cramer, chief engineer, Water Works Co., Lexington, Ky., spoke of selling at home a 6 per cent issue of preferred stock within 3 days. In each case the company undertakes to sustain the market price by taking the stock back.

C. M. Roos, secretary, Cairo Water Co., described a strenuous and somewhat dangerous search in the Kentucky field by automobile for coal during the miners' strike. Finally, after an experience in the operation of a wood lot with gasoline saw rigs, a small mine was purchased.

The water witch still has some followers in Illinois. Alex Van Praag, consulting engineer, Decatur, had to extend the number of test holes drilled at Mt. Pulaski to satisfy the believers in the occult. If this town had made tests 26 years ago it would have saved, he said, two sets of pumps and wells both outgrown because wrongly located.

E. R. Shepard, consulting electrical engineer, Chicago, stated in his paper on "Status of Electrolysis" that there is much less damage now than formerly. He described the tests being undertaken by the U. S. Bureau of Standards to learn soil corrosion and electrolysis effects on several thousand samples of pipes buried over the country.

Illustrated descriptions of the recently completed storage dam and the sewage treatment works at Decatur were given by S. A. Greeley, consulting engineer, Chicago, and F. D. Holbrook, consulting engineer, Decatur.

After a luncheon at the Country Club of the H. Mueller Manufacturing Co., and a trip through the company's factory, excursions were made to these water and sewage works which are costing this city of 45,000 people a total of about $55 per capita.

Municipal water softening status in the state was outlined by A. M. Buswell, chief, State Water Survey. He brought out that the hardness range in most Illinois waters begins at the point (200 p.p.m.) where the hardest waters in New England leave off. Fifty-eight supplies have total solids in excess of 1,000 p.p.m.

H. F. Ferguson, sanitary engineer, State Department of Health, has been making a survey of Illinois filter plants and factors affecting operation for the committee of the parent society on permissible loading of filters. The tabulated results are available in blueprint form.

Howard Ely, superintendent, Danville Water Co., in leading a round-table discussion on filter problems noted the successful removal of tastes and odors by means of copper sulphate and the areator described in *Engineering News-Record*, July 13, 1922, p. 70.

The newly-elected officers are as follows: Chairman, C. M. Roos; vice-chairman, A. M. Buswell; treasurer, H. E. Keeler; trustee, W. E. Lautz.

# *A. A. E. Nominates Four For President*

*Four geographical sections of the country are represented in the four nominees for president of the American Association of Engineers, biographies of whom are given herewith. The annual meeting of the Association is to be held in Norfolk, Va., May 7-9, though the ballot for officers will be taken before, the polls closing April 27.*

### Webster L. Benham

Webster L. Benham is a graduate of Columbia University from which institution he received a C.E. degree in 1905. His early professional career was with the New Jersey Zinc Co., in private engineering work in Oklahoma City and as assistant city engineer of Oklahoma City, Okla. From 1909 to 1918 he was president of the Benham Engineering Co. of Oklahoma City, joining the army at that time and becoming a major in the Construction Division. At the present time he is owner and chief engineer of the Benham Engineering Co. of Kansas City and Oklahoma City, consulting engineers engaged in general municipal and industrial engineering work. He is a member of various technical societies and has served the American Association of Engineers both in committee work and as national director.

### Frank T. Payne

After his graduation from the University of Alabama, Frank T. Payne was engaged for ten years in railroad engineering work for the Southern Pacific, Atlantic System, National Railways of Mexico, and the Illinois Central R.R., working his way from rodman to assistant engineer. Five years thereafter he was in general engineering practice, including municipal work and construction of industrial plants. Later he served as city engineer of Gretna, La. Since 1904 he has been chief engineer of the Department of Conservation of the State of Louisiana. He was the first president of the New Orleans Chapter of the A.A.E. and has been active in committee work, having served as chairman of the committee on resolutions at the eighth annual convention.

### Robert I. Randolph

Robert Isham Randolph, who is secretary of the Randolph-Perkins Co., engineers and managers of Chicago, was educated at Cornell. After graduation he was employed by the Sanitary District of Chicago and placed in charge of construction of a bascule bridge across the Chicago River at Dearborn and 22nd Sts. Later he was secretary of the Internal Improvement Commission of Illinois and secretary of the Rivers and Lakes Commission of the same state. Still later he became a junior partner of Isham Randolph & Co., consulting engineers of Chicago and Jacksonville, Fla. During the war he served two years in the service as major of engineers, commanding the 535th Engineers. He is a member of various technical and social clubs of Chicago and is past president of the Chicago Chapter of the Association.

### George E. Taylor

George E. Taylor, since 1920 junior partner in the consulting engineering firm of Anderson & Taylor, of Morganville, W. Va., received his technical education in that state. Upon his graduation he was made assistant engineer of the Public Service Commission of West Virginia. He then became chief engineer of the Public Service Commission and a silent partner of the George R. Clarke Co. of Clarksburg, W. Va. His company is employed in valuation and rate cases by large public utility corporations in the West and South. Besides being a member of various technical societies, he has contributed both to the technical press and to technical literature. He is secretary of the State Board of Registration for Engineers in West Virginia. He has served the Association as president of the Charleston Chapter and vice-president of the national Association.

## Water Tank Above Stair Tower Fails at Hartford

**Nine Dead Include Contractor—Tank Filled Three Weeks Ago—Load Carried By Brick Walls**

Collapse of the tower supporting a 50,000-gal. water tank caused the death of nine men at the new plant of the Fuller Brush Co., Windsor Ave., Hartford, Conn., on Mar. 31. Among the dead was J. F. Bent, vice-president of the R. G. Bent Co., general contractors for the tower. Thirty-four persons were in the tower just before the collapse, and it is remarkable that so many escaped; four were seriously injured. The accident occurred at 11:35 a.m., shortly before the men would have stopped work. The steel tank was placed in the top of a 40-ft. square tower 160 ft. high, at the center of the front face of the building. The tank was supported by four inclined steel posts about 20 ft. long, the bottom ends of which were embedded in a heavy reinforced-concrete floor. The thrust was carried by clevis rods, also embedded in the floor. This supporting floor was carried by the four brick walls without steel columns.

The main entrance to the building was through the tower, which also contained elevators and stairs to serve the four floors of the building. The tower was nearly completed, and the sprinkler system served by the tank was in operation, the tank having been filled three weeks previously. Because of the rescue work, much of the evidence required in placing the blame was soon destroyed by dynamite, oxyacetylene torches, and steam shovel. Several investigations are being made, among them being those made by the coronor and the states attorney; by H. G. Balcom, consulting engineer, representing both the Fuller Brush Co. and the firm of Buck & Sheldon, architects and engineers for the tower; by the Hartford superintendent of buildings, with the aid of A. S. Lynch, consulting engineer; by E. H. McClintoch, of McClintoch & Craig, architects and engineers, representing the Holyoke Valve & Hydrant Co. of Holyoke, Mass., subcontractors for the tank and sprinkler system; and by James Bush and others, representing the Aetna Insurance Co., whose liability loss was about $50,000. The property loss was about the same.

No reliable attempt can be made to determine the cause of the disaster until the reports of these several investigations are rendered. All parties concerned in the design and construction of the tank have enviable reputations, and no expense had been spared to make the tower as strong as seemed necessary.

The masonry tower will be rebuilt to provide for elevators and stairs, but a new tank, independently supported, will be placed in the rear.

## New Labor Contract in Chicago on Landis Award Basis

The Chicago Building Trades Council has recognized the principles of the Landis Award for three years in an agreement signed recently with the Building Construction Employers Association. Working conditions laid down in the Landis Award are to be the basis for all negotiations between the unions and the contractors' association.

## Contract for 330-Mile Railway Let in West

**The Wyoming North & South R.R. has awarded a contract to Peterson, Shirley & Gunther, Omaha, Neb., for the construction of its line from Casper, Wyo., through Sheridan to Miles City, Mont., a distance of 330 miles. The contractors have commenced work at Casper and have established headquarters at Sheridan, Wyo. It is expected to complete the line in 1924.**

## Suit Against St. John Cantilever

The attorney general of the Province of New Brunswick has instituted suit against the Canadian Pacific Ry. demanding an injunction to compel the company to remove its new steel cantilever bridge over the mouth of the St. John river at St. John, N. B., on the claim that the bridge is a menace to navigation. Shipping interests allege that unless the bridge is raised 7 ft. it will be an impediment to navigation up the St. John river from St. John harbor and the Bay of Fundy, and that schooners bound up the river to load lumber have lost topmasts while passing under the bridge. Similar claims were laid before the Canadian Railway Commission last year, but the change demanded was denied. The company claims that the attorney general of New Brunswick has not the proper jurisdiction to seek an injunction, and that only the minister of justice (attorney general) of Canada has jurisdiction over matters affecting navigation. It is likely that testimony, argument and judgment on the demand will consume several months.

## Pinchot Highway Conference Well Attended

Delegates from over a score of states attended the conference of highway officials called by Governor Pinchot at Harrisburg, Pa., March 23 and 24. Papers were presented by Thomas H. MacDonald on highway construction and maintenance from the national standpoint; by Frederick Stuart Greene on experience by the states in road construction; by Charles J. Bennett on experience of the states in traffic regulation; and by H. G. Shirley on experience of the states in road maintenance. The papers were brief summaries of existing practice and made no attempt to offer new information or to suggest policies for future practice.

Discussion was active and at times frankly critical of the attitude of state administrations toward highway development. Playing politics in highway affairs was bluntly condemned. Two other facts on which stress was laid were: that selection of road types is an engineering problem to be solved differently as traffic requirements and natural conditions differ and that traffic surveys conducted comprehensively and in a uniform manner are essential to the economic selection, design and classification of highways.

On Friday evening the official delegates were entertained at dinner by Governor Pinchot and on Saturday there was a luncheon and round table discussion with Commissioner P. D. Wright, Pennsylvania Highway Department, presiding.

## Feiker Again Joins Secretary of Commerce Staff

At the request of Secretary Hoover, of the U. S. Department of Commerce, F. M. Feiker, Assistant to the President of the McGraw-Hill Co., Inc., has again been granted leave of absence to undertake the organization and general direction of the world surveys of raw material supplies, rubber, sisal hemp, nitrates, etc., for which Congress recently made an emergency appropriation of $500,000. Mr. Feiker served as assistant to the Secretary of Commerce during the first year of Mr. Hoover's administration, acting as general assistant in organizing the personnel and industrial trade contact committees in relation to the Bureau of Census, the Bureau of Standards, and the Bureau of Foreign and Domestic Commerce.

## River and Harbor Expenditures Not Yet Allocated

*Washington Correspondence*

Some confusion has resulted from what turns out to be a false report circulated by a Washington newspaper to the effect that Secretary of War Weeks was going to allocate most of the $56,000,000 appropriated for river and harbor work by the last Congress to the Ohio and the Monongahela Rivers. The day following the publication of the report Secretary Weeks told the reporters that there was no basis for such a statement, that the department had not yet attempted to allocate the appropriation to specific projects, and that certainly it would not give so disproportionate an amount to the rivers mentioned.

He further explained that while the War Department, through the Chief of Engineers, had submitted to Congress a detailed report in which the amount which could profitably be spent on various rivers was given for each river and while the sum of these amounts formed the basis for the $56,000,000 appropriated, there was no law requiring the Secretary of War to allocate the money appropriated according to any such system. In other words, the Secretary could designate the amount to be spent on any project regardless of the preliminary report of the Chief of Engineers.

It will be remembered that the federal budget called for only $27,000,000 for river and harbor work, but that Congress raised it to the higher sum noted over the protest of the President.

## Trenton Sewage-Works Controversy Begets Suit and Protest

As a continuation of the campaign to force Trenton to build sewage-works and the State Board of Health to act on the plans for the direct-oxidation process submitted for approval last December, the city commission of Bordentown has adopted a resolution of protest against the delay in which it alleges that its health and prosperity are threatened. In addition, John R. Thropp filed a suit in Federal District Court at Trenton on March 29 for $100,000 damages alleged to have been caused to his property at Morrisville, Pa., by the discharge of untreated Trenton sewage into the Delaware River.

## Engineering Societies

### Calendar

**Annual Meetings**

NATIONAL CONFERENCE ON CITY PLANNING, New York; Fifteenth Conference, Baltimore, April 30-May 2.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Spring Meeting, New Orleans, La., April 18-20.

NATIONAL FIRE PROTECTION ASSOCIATION; Boston; Annual Meeting, Chicago, May 8-10.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Detroit, Mich., May 21-25.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

**Tri-State Water & Light Association** will hold its annual convention at Birmingham, Ala., Apr. 17-20. The headquarters, including the exhibit, will be at Hotel Hillman. Invitations to join the association have been extended to water-works men in Alabama, Florida, and eastern Tennessee. The president of the association is J. E. Gibson, manager and engineer, Water Department, Charleston, S. C., and the secretary is W. F. Stieglitz, Columbia, S. C.

**The Society of Safety Engineers of California** at the annual meeting in San Francisco on March 22 elected officers for the ensuing year as follows: president, William S. Wollner, Northwestern Pacific R.R.; vice-president, E. W. Bullard, safety engineer; secretary, H. M. Wolfin, superintendent of safety, State Industrial Accident Commission.

**The County Surveyors Association of California** at the annual meeting in Sacramento, Calif., on March 12 and 13 elected officers for the ensuing year as follows: President, H. H. Hume, county engineer of Butte County; and secretary, Lloyd Bowman, county surveyor of Santa Cruz County.

## Personal Notes

GEORGE W. SAATHOOF, chief engineer for the Cities Service Corp., accompanied by S. W. MCPHEE, engineer also connected with the Cities Service New York office are in Denver, Colo., making preliminary plans to start the erection of a $4,000,000 power plant for the Cities Service, at a point near Boulder, Colo.

F. P. SHEARWOOD has been elected to succeed Walter J. Francis as vice-president of the Engineering Institute of Canada. Mr. Francis was, as noted in these pages last week, elevated to the presidency of the Institute upon the death of Arthur St. Laurent.

E. H. MCGOVERN has been appointed office engineer of the Cleveland, Cincinnati, Chicago & St. Louis Ry., with headquarters at Cincinnati, Ohio. He succeeds F. H. PLAISTED, who has resigned.

CHARLES W. STANIFORD, civil and consulting engineer, of New York City, has been appointed consulting engineer for the city of San Diego, Calif., in planning the future development of the port of that city. Mr. Staniford has left for the coast to undertake this new work.

F. M. FAUDE has been appointed chief hydraulic engineer of the Railroad Commission succeeding C. I. RHODES, resigned. Mr. Faude has been with the commission for five years as assistant hydraulic engineer and during a six months' period, in the absence of the head of the division, served as acting chief engineer.

FRED DAVENPORT has entered consulting engineering work under the firm name of Davenport Engineering Co., and is located at Fort Wayne, Ind., having formerly done consulting work in the city of Kokomo, Ind.

W. A. MUELLER has recently entered the engineering service of the City of Louisville, Ky., being employed as senior inspector in the Department of Sewers. He has but recently left the Illinois Highway Department where he was employed as resident engineer.

E. F. BANKSTON, former assistant bridge engineer for the county engineer of Nez Perce County, Idaho, has become associated with the Missouri Highway Department where he is employed as project engineer.

WILLIAM P. GRASS is now chief engineer of the Pacific Phenols Co., Guerneville, Calif. He was formerly resident engineer with the Santa Cruz County Highway Commission.

ERNEST W. SEEMANN has severed his connection with the Elgin, Joliet and Eastern Ry Co., where he was employed in the chief engineer's office as designing draftsman, to become associated as civil engineer with Cowin and Co., Inc., Minneapolis, fabricators of reinforcing bars.

R. O. PARSONS, formerly assistant engineer with the Georgia State Highway Department, has become resident engineer with the Kentucky State Department of Roads.

BEN T. SANDERS, formerly county engineer of Pickens County, Ala., has accepted a position as superintendent of construction with the Batson-Cook Co. of West Point, Ga. He is located at Beaufort, N. C.

HERBERT PHILLIPS, engineer in charge of construction of hydro-electric stations for the New Brunswick government, has resigned from the St. John Electric Commission.

GEN. W. H. ROSE has resigned as manager of the New York branch of Lockwood, Greene & Co., engineers and managers, to become associated with the American Machine & Foundry Co., of New York City. General Rose became connected with Lockwood, Greene & Co. in New York after his resignation from the army in 1919. During the war he was a brigadier-general in charge of the Division of Purchase, Storage and Traffic. Prior to the war, as a major of Engineers, he was in responsible charge of all electrical design, construction, and operation and maintenance for the Panama Canal.

J. ROWLAND BIBBINS, former manager of the Department of Transportation of the U. S. Chamber of Commerce, has established a consulting office in Washington, D. C. He will engage in work having to do with transportation development, including complete surveys and economic studies adapting traffic, transit, railroad and port terminals, motor transport and city plans and valuation.

HOWARD J. WILLIAMS, formerly assistant engineer with the Maine Water Power Commission, has resigned to accept a position with the Vaughan Engineers of Boston.

JOSEPH HARBER, formerly construction engineer with P. Roberts & Co., and later with the Wolf Contracting Co., both of New York City, has formed a contracting corporation under the name of the Harber Contracting Co., Inc., with offices and shops at 244 W. 30th Street, New York City. The company will do all kinds of general contracting and building work including alterations.

## Obituary

GEORGE F. KESSLER, one of the best-known American city planners and landscape artists, and who was consultant in city planning to both the Kansas Citys, as well as adviser to many other cities, died in Indianapolis March 19. He had been connected with park development in Kansas City, Mo., for 30 years.

MICHAEL SKIFF, aged 53, prominent contractor of Pueblo, Colo., was killed March 21, when the auto truck in which he was riding skidded and turned over.

ERNEST J. HYNES, Denver contractor of the firm of Grier and Hynes, died in that city March 6.

BARTON F. HOWE, junior engineer in the Water Resources Branch of the United States Geological Survey, was drowned March 3 while making a discharge measurement of the Delaware River at Milldrift, Pa. He had endeavored to make measurements while the river was ice covered and the ice gave way, the swift current pulling him underneath it. He was a graduate of the engineering college of the University of Vermont. During the war he was an officer in the aviation service, having served overseas for several months. He had been connected with the Albany, N. Y., office of the U. S. Geological Survey since September, 1919.

# From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

## Conference Reports on Business Cycles

**Results of Study of Unemployment, Booms and Depressions Issued by Dept. of Commerce**

EIGHTEEN months ago the President's Conference on Unemployment met in Washington under the auspices of the Department of Commerce and Secretary Hoover. It was called primarily to consider relief for the four to five million unemployed which had then resulted from the business slump of 1921. At that time it formulated emergency measures which probably had a good deal to do with alleviating the unemployment situation, but since then it has been making a further study which has resulted in a report entitled "Business Cycles and Unemployment," just issued by the U. S. Department of Commerce.

In this report the committee analyzes the economic phenomena of periodic booms and depressions, and its conclusions are that preventive measures lie in the better handling of business in times of prosperity, because depressions are due to over-expansion, inflation, loss of efficiency, waste and extravagance in the boom periods. It is felt, therefore, that the first point of attack on the problem must be more informed action by business men in periods of rising markets in order that excessive expansion may be prevented and the extent of the decline reduced. In other words, the committee feels that there is such a thing as a business cycle and that business executives generally should keep informed regarding it.

### To Prevent Inflation

Suggestions for curbing excessive expansion include recommendations as to the control of credit by individual banks, possible control of inflation by the Federal Reserve system, control by individual business men of expansion in their own business, and the retardation in boom times of governmental and large utility building and construction. It is interesting to observe that the last recommendation has just been carried out by Secretary Hoover to meet the rising costs of construction.

The committee, however, considers that before any constructive action can be taken there must be gathered and constantly disseminated fundamental information from which trends in business can be properly adjudged by individual business men, and it strongly recommends the recruiting of enlarged and more systematic statistical information by the Department of Commerce and its wider dissemination. It points out that the construction industries are to some extent, at least, the balance-wheel on the ebb and flow of boom and depression, because construction is more readily controllable than the demand for consumable goods. Other suggestions are that the Federal Reserve Bank may earmark a special reserve of gold as against probable future gold shipments from the United States and "thus accomplish the double object of preventing both temptation to inflation of credits on the basis of this surplus gold supply and at the same time the great embarrassment of possible financial credit difficulties that would arise if foreign drafts were made upon the gold which had been used as a credit basis."

### Engineers Queried

In a final questionnaire to various businesses and professions the section addressed to engineers is as follows:

"To what extent can improvements in methods of production and organization of marketing in each industry relieve the business cycle? What are the difficulties now in the way of making these improvements, and how can the difficulties be removed?"

An exhaustive report on the subject has been prepared at the request of the committee by the National Bureau of Economic Research.

## Brick Association Elects Officers

At a meeting of the board of governors of the National Paving Brick Manufacturers' Association, held in Cleveland, March 22, the following officers were elected: Chairman of the board, O. W. Renkert, president, Metropolitan Paving Brick Co., Canton, O., succeeding Spencer M. Duty, president, Medal Paving Brick Co., Cleveland, O.; president, R. T. Hutchins, vice-president and sales manager, Mack Manufacturing Co., Wheeling, W. Va., succeeding O. W. Renkert.

R. T. Hutchins

The following officers were re-elected: W. P. Blair, Cleveland, first vice-president; C. C. Barr, president, Barr Clay Co., Streator, Ill., treasurer; Edward E. Duff, Jr., Cleveland, executive secretary and Stanley A. Knisely, Cleveland, assistant secretary.

## Agree on Lumber Sizes

At a meeting of the Standardization Committee of the National Lumber Manufacturers Association, held in New Orleans, March 24, in connection with the annual meeting of the association, an agreement was reached among the representatives of all constituent associations of the national body, except one which was not represented when the action was taken, upon standard finished sizes of lumber, as follows: That 25/32 in. shall be the standard finished size, surfaced two sides, of all grades of 1-in. lumber, kiln dry basis, and 1⅝ in. as the surfaced thickness of small dimension.

## Plan to Curb Inflation in Construction Industry

**General Feeling Among Manufacturers and Contractors Favors Conference to Spread Work**

*Washington Correspondence*

ORDERS for construction materials are pouring in upon manufacturers in such volume and the program of private building during 1923 has reached such proportions that many representatives of the industries affected have suggested that a conference be held to forestall a runaway market for both labor and material.

Estimates from the headquarters in Washington of the Associated General Contractors indicate a building and general construction program, including highways, of $6,000,000,000 under contract or contemplated for 1923; this is $1,500,000,000 in excess of the total for 1922. Reports to the association, as of March 1, indicated stocks of materials lower than on the same date last year, with producing plants having orders on hand to the limit of their capacity for several months to come. At the same time, reports from practically all sections of the country showed demand for labor strong, with a tendency toward wage advances.

The Associated General Contractors sent a letter to 250 organizations and large manufacturers, representing all lines of production interested in construction work, calling attention to the situation. Replies from more than 200 have been received, indicating a general feeling in favor of a conference of contractors, material men and labor to find a means of spreading out the work.

## Ryerson Buys Plant of Cincinnati Iron & Steel Co.

Joseph T. Ryerson & Son, Inc., with main plant and offices in Chicago, have purchased the plant, stock and good will of the Cincinnati Iron & Steel Co., Cincinnati, Ohio. The Ryerson company will now have six steel-service plants, at Chicago, St. Louis, Detroit, Buffalo, New York and Cincinnati.

L. E. Skinner

The newly acquired plant occupies a full city block with about 110,000 sq.ft. of floor space. The stock contains iron and steel products, including bars, shapes, plates, sheets, tubes, rivets, bolts, nuts, pipe, etc. Modern cutting equipment and handling facilities will be improved to make possible a 24-hr. shipping schedule.

Lewis E. Skinner, who has served 18 years with the Ryerson company is in charge of the Cincinnati plant. He will be assisted by C. A. Parnell, former assistant to Arthur Allshul, at the Ryerson plant at Buffalo.

## Lime Association to Meet

The fifth annual convention of the National Lime Association will be held at the Hotel Commodore, New York City, June 13-15.

## Record Runs May Mislead Equipment Users

### Unusual Performances Mean Little Without Full Details of Local Conditions

*Supplementing the discussion in last week's issue (p. 602) other manufacturers this week state the policies of their organizations. One of them makes some pertinent comment on the solicited testimonial.*—EDITOR.

BY HAROLD E. SMITH
President, The T. L. Smith Co., Milwaukee

THERE is no denying the fact that it would be unfair and poor policy for any reputable manufacturer to use any language in his advertising which would give a wrong impression to any reader. It is also quite possible that the publication of figures representing record runs made with machines over short periods of time might be misleading not only as to the amount of work which can be done on any job in one year, but also as to the particular value of the performance of that machine on that job.

There are a great many jobs which it would not pay to organize for high daily capacity and the fact that large records were not made on these jobs should not be held against the contractor or any of the contractors' machinery. It is equally true that where a job is highly organized and equipped the contractor has a right to expect frequent large daily output and large average output and the fact that he secures it should not be considered anything unusual for advertising purposes.

But there are a great many jobs where the daily production has been unusually high—not for short periods of time, but over an extended period—and the cost unusually low. In such cases all of the credit should go to the contractor. Often, however, he admits that his record was partly due, at least, to the sturdiness, speed and dependability of certain units of machinery which he used, and that other competing machines lack the qualities necessary to have equalled this performance. In a case of this kind there is justification for an advertisement featuring the record performance by the manufacturer of the machinery; the manufacturer has rendered a service to his industry and is rendering a further service by letting other contractors benefit by the knowledge of this performance.

There is considerable difference in the design, cost, and quality of competing types of contractors' machinery. Some are better, faster, and more reliable than others. The manufacturer who pays more for the manufacturing of his machine and sells it at a higher price because of this quality can hardly submit to a policy of advertising which would prevent him from claiming superior speed and productive capacity for his machine. In the case of concrete mixers there are a great many elements of speed other than the speed of mixing. The mixing time is practically always fixed and should be rigidly adhered to by the contractor. But if one machine can consistently load, discharge and distribute faster than another make, and can consistently work day after day with less interruption and delay from breakdowns and troubles than another machine, then the manufacturer can justly claim greater speed without misleading the public and without, in any way, working at variance with the aims of the engineers and the road officials in securing the best possible mixture of concrete.

To summarize, it would be unfair to the manufacturer of the fast, dependable unit if he could not make some truthful and carefully-worded statements in his advertising regarding what his machine has done or can do in regard to steady record performance.

BY HARVEY T. GRACELY
Advertising Manager,
Marion Steam Shovel Co., Marion, Ohio

THE publishing of record runs had far better be left to the editor of a publication than to the ad writer. Local conditions and the elements have so much to do with cost and output that it is very unfair to publish unusual experiences and then, by inference, leave the reader to draw the conclusion that such performance can be expected under his particular working conditions, regardless of what they may be. We are now and always have been opposed to such a policy and I believe a review of our advertising matter will fully substantiate this attitude.

We would like to go a step farther, however, and object to the procedure of certain manufacturers in soliciting testimonials. The practice of obtaining statements from users by intensive solicitation, involving in many cases compensation for exaggerated statements, is so decidedly unethical that no conservative and well-meaning manufacturer should countenance it in any way. Such things do happen, however, and are still believed by some of the more unscrupulous to be a fair way of getting business.

Frankly, the Marion Steam Shovel Co. has always believed in conservative statements on output and costs, and has been a consistent believer in advertising its products strictly on the merits of construction and performance. We use testimonial advertising only where we think the data and information are helpful to the user. We avoid direct solicitation, feeling that the genuine, sincere expression of endorsement is far more to be preferred than any self-written, signature-requested statement.

*(To be continued)*

## Business Notes

COL. WALTER J. RILEY, president of the O. F. Jordan Co., East Chicago, Ind., manufacturers of spreaders and other railway specialties, is home after a tour of South America.

HENRY H. ASHLEY, president, Hazard Manufacturing Co., Wilkes-Barre, Pa., makers of wire rope, died Jan. 20.

BECKWITH MACHINERY CO., Pittsburgh, which has an office and warehouse in Cleveland, has moved to a new and more centrally located office and warehouse in the latter city at 1259-61 Central Ave. Growth of the business and the need for larger warehouse facilities is given as the reason for the change.

JOHN B. WIGHT, for many years manager of the New York office of the Alpha Portland Cement Co., until his retirement a year or so ago, and a commissioner of the District of Columbia from 1897 to 1900, died at his home in Montclair, N. J., March 31.

HAROLD L. BOND and his son Harold C. Bond have resigned as president and secretary, respectively, of Waldo Bros. & Bond Co., Boston, dealers in contractors' equipment. Their future plans have not yet been announced.

WILLIAM H. SCHUTTE, who has been identified for a long time with the Chicago selling force of the Blaw-Knox Co., has been promoted to the managership of its Chicago office.

THOMAS J. DOLAN, Chicago, dealer in contractors' railway supplies and equipment, announces the organization of a new company under the name Dolan - Tucker - Smith Equipment & Supply Co.

GIBB INSTRUMENT CO., Bay City, Mich., manufacturers of electric welding equipment, has opened a sales office in Cleveland, Ohio, at 2104 East Superior Ave., in charge of W. O. Little.

FREDERIC E. WHEELER, formerly president, Finlay-Wheeler, Inc., contractors' equipment dealers of Buffalo and Rochester, N. Y., has joined the Chicago sales staff of Blaw-Knox Co., Pittsburgh.

CONCRETE STEEL CO., New York, producer of Havemeyer steel bars for reinforcing concrete, elected the following officers at its recent annual meeting: Chairman, J. F. Havemeyer; president, W. H. Pouch; secretary and treasurer, H. T. Bahr.

HARDWOOD MANUFACTURERS INSTITUTE, Chicago, announces its first annual convention for May 10 and 11 at the Blackstone Hotel, Chicago.

CALIFORNIA GLAZED CEMENT PIPE CO. announces the change of its firm name to the Bent Concrete Pipe Co., Los Angeles. The company, during thirteen years, has manufactured machine-made concrete pipe. The Bent Concrete Pipe Co. has taken over the reinforced-concrete pipe business of Bent Bros., contractors. The officers and owners of the company are Ernest F. Bent, president and manager; W. L. Jencks, treasurer and assistant manager; B. J. Primmer, secretary and general superintendent; Arthur S. Bent, of the contracting company bearing his name, and H. Stanley Bent, both of Los Angeles.

SHUNK MANUFACTURING CO., Bucyrus, Ohio, has closed a contract with S. Franklin Henderson, owner of patents on a motor truck hoist and body, for the exclusive manufacture of this equipment. The Henderson hoist is the same product that the Ohio Crane Co., of Bucyrus, had planned to produce. Hoist and body have been approved by the Packard, White, General Motors and Garford companies. Benton Hopkins, of Cleveland, has been appointed superintendent in charge of production of the hoists and bodies at the Shunk plant. The equipment is suitable for trucks varying in capacity from 2 to 10 tons.

# Equipment and Materials

## New ½-Bag Tilting Mixer

To its line of concrete mixers the T. L. Smith Co., Milwaukee, has just added a new ½-bag tilting unit with a capacity per batch of mixed concrete of 3¾ ft. The machine, called the Smith 375, has a double-cone drum and is designed for speedy discharge. Two types of mounting are furnished, the first a two-wheel pneumatic-tired trailer with 30 x 3½-in. Ford tires, and the second, a frame carried on four metal wheels.

## Crawler Dredge Digs Ditches Between Fruit-Bearing Trees

For ditching between rows of fruit-bearing trees only 30 ft. apart in the orange and grape-fruit groves of the Fort Myers Grove Co. in Florida, a 1-yd. crawler dredge with special features has been designed by the Bay City Dredge Works, Bay City, Mich.

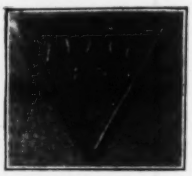
The work involved both the cleaning out of old ditches and the excavation of new ones in an existing grove of 800 acres and the development of 1,000 to 2,000 additional acres. It was essential, in the ditching operations, that the trees should not be damaged.

The material to be excavated consists of hard water-sand overlying lime rock. The ditches are from 3 to 4 ft. wide at the bottom and 8 to 12 ft. wide at the top. The hard character of the material led to the selection of a dipper rather than a drag-line for the excavation. Furthermore, a full circle machine could not be employed on account of the close spacing of the rows of trees, preventing a machine from operating at the side of the ditch. The crawler dredge, therefore, was designed to straddle the ditch; it has a clear span between crawlers of 14 ft. and an overall width of 20 ft. The outfit is mounted on four crawler treads, each 2 ft. wide and 8 ft. long. The gross weight of the equipment is 64,800 lb. On this type of work it has been found that the crawled traction is desirable because, on account of the comparatively small yardage of earth to be taken out, the machine must be able to move rapidly to work at capacity.

Power is furnished by a two-cylinder opposed type 45-hp. kerosene engine manufactured by the Reliable Tractor & Engine Co., Portsmouth, Ohio. The dipper, with a capacity of 1 cu.yd., is made of heavier plates than standard design and has a manganese steel lip and teeth.

## Corrugated Culverts Marked With a Date Tag

A triangular metal date tag is now being attached to all corrugated culverts of Armco ingot iron manufactured by the American Rolling Mill Company, Middletown, Ohio, and sold by distributors in the United States and Canada for cross-drain structures under highways and railroads. This tag, which is riveted to the interior of the culvert on the upstream end, is intended not only to prove the manufacturer's claim of long life for these culvert pipes. This tag is intended not only to give the manufacturer and distributor definite information regarding the life of the metal culvert, but to save the engineer in checking the durability of the material he specifies.

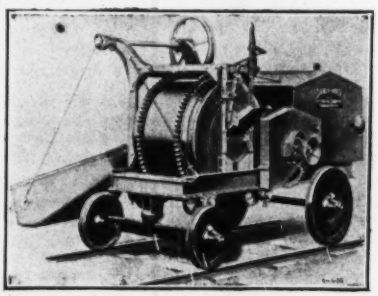


## New Tracing Paper Is Strong, Transparent and Color Fast

A tracing paper for which a number of advantages, such as strength, transparency and color-fastness, are claimed by its maker, the New York Blue Print Paper Co., New York City, has been placed upon the market under the trade name of Vellux. In the matter of strength the company claims that this paper is the next best thing to tracing cloth and stands erasing well and takes ink readily. Its transparency is said to excel that of any other paper and the fact that it does not yellow with age makes it a fast paper to use in running off blueprints.

## Mixer Mounted on Flanged Wheels for Railroad Use

For railroad work the Koehring Co., Milwaukee, has mounted its small Dandie concrete mixer on flanged wheels, the idea being to haul the unit on the tracks with a gasoline motor car. The outfit is supplied in sizes of 4 and 7 cu. ft. of mixed concrete per batch. This machine is designed for handling odd jobs along the right-of-way, including culvert work, signal bases, culverts, station platforms, and small retaining walls. It may be removed from the rails without the necessity of laying track. The drum has a double-gear drive and the discharge chute may be controlled from either side. The equipment may be had with low-charging platform or power charging skip, automatic water-measuring tank and light-duty hoist.



# Publications from the Construction Industry

*Scientific Street Lighting* — HOLOPHANE GLASS CO., INC., New York, has embodied in a 22-p. illustrated booklet a guide to good practice in street lighting. In its engineering aspect the trend is said to be toward the extension of ornamental lighting, closer spacing in non-ornamental lighting, greater mounting height, and higher intensity values. Each of these phases of the subject is discussed and details are given regarding the Holophane refractor designed to distribute light from lamps to best advantage.

*Ancient and Modern Construction*—KOEHRING CO., Milwaukee, has issued a 31-p. booklet, illustrated with etchings in color, which presents in text and picture examples of notable ancient and modern construction embodying the element of permanency. The volume entitled "Built to Endure." The subjects range from the Colosseum, Rome, to the new baseball stadium of the New York "Yankees."

*Building Construction* — THOMPSON-STARRETT CO., New York, reproduces in an attractively illustrated volume extracts of letters of commendation from its clients for whom buildings of all types—residences, offices, institutional structures, theaters and industrial plants—have been erected. The frontispiece shows New York's skyline with 15 structures marked to indicate Thompson-Starrett work. The policy of the company is expressed in a foreword by President L. J. Horowitz, who says: "After all, a contract for a building is secondary in importance to a clean bill of health when the work is done."

*Brick Paving Filler* — THE TEXAS CO., New York, has added to its literature on paving a booklet outlining recommended practice in the use of asphalt filler for brick and vitrified block pavements. The new publication is illustrated and consists of 28 p., dealing with such subjects as the process of production, shipping, preparation of the filler for use, and methods and equipment for its application. Under the latter head are detailed nine steps covering the preparation of the surface and the application of the filler.

*Natural Cement*—THE CARNEY CO., Mankato, Minn., in a 22-p. illustrated booklet describes the characteristics and uses of its product, made from natural rock, for mortar in building operations. It is usually mixed in the proportions of 1 part natural cement to 4 parts sand. There is a list of several hundred structures in which the Carney product has been used.

# Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

## March Contracts Heaviest on Record

### Average Weekly Value of Construction Awards 30 Per Cent Heavier Than Same Month in 1920

March contracts awarded in the five issues of *Engineering News-Record* totaled $240,349,000, against $123,742,000 in the four issues of February. This represent an average weekly value of $48,000,000 for March, compared with $31,000,000 during the preceding month. The number of awards totaled 912 during March, with an average value of $263,000, against 483 in February, averaging $257,000 per contract.

The weekly average, $48,000,000 for March of the current year, represents an advance of 30 per cent over the average of $37,000,000 per week for lettings valued at $148,000,000 in the four issues of *Engineering News-Record*, March 1920.

Minimum costs observed in Construction News on each class of construction are as follows: Waterworks, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings $150,000.

**Engineering News-Record Construction Cost Index Number**

| | |
|---|---|
| April, 1923 | 213.50 |
| March, 1923 | 205.25 |
| April, 1922 | 164.72 |
| Peak, June, 1920 | 273.80 |
| 1913 | 100.00 |

**Engineering News-Record's Construction Cost Index Number advanced 8.25 points since last month, due to higher steel prices and stiffening in labor rates. Steel rose to $2.50 from $2.25 per 100 lb., Pittsburgh mill. The average rate for common labor is now 50c. Thus, general construction cost is 30 per cent higher than one year ago and 22 per cent under the peak; it is 113 per cent above the 1913 level.**

**Engineering News-Record Construction Volume Index Number**

| | | |
|---|---|---|
| Monthly | | |
| **March, 1923** | *(5 issues of E. N.-R.)* | 195 |
| February, 1923 | *(4 issues of E. N.-R.)* | 105 |
| March, 1922 | *(5 issues of E. N.-R.)* | 202 |
| 1913 | | 100 |
| Yearly | | |
| 1922 (entire year) | | 130 |
| 1921 (entire year) | | 88 |
| 1920 (entire year) | | 91 |
| 1913 | | 100 |

**Engineering News-Record's Construction Volume Index Number is 195 for the month of March, and 130 for the whole of 1922, as against 100 for 1913. This means that the actual volume of construction in 1922 (not the mere money-value of the contracts let that year) is 30 per cent above the volume of construction for 1913. Our monthly volume number, 195 for March, 1923, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.**

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA DURING MARCH, 1923

| | New England | Middle Atlantic | Southern | Middle West | West of Mississippi | Western | Canada | Total |
|---|---|---|---|---|---|---|---|---|
| Waterworks | $264,000 | $10,595,000 | $130,000 | $2,618,000 | $1,166,000 | $137,000 | $239,000 | $15,149,000 |
| Sewers | ..... | 721,000 | 7,000 | 2,522,000 | 803,000 | 257,000 | 167,000 | 4,477,000 |
| Bridges | 25,000 | 3,001,000 | 482,000 | 292,000 | 1,735,000 | 186,000 | 58,000 | 5,779,000 |
| Excavation, drainage and irrigation | ..... | 304,000 | ..... | 100,000 | 514,000 | 28,075,000 | ..... | 28,993,000 |
| Streets and roads | 153,000 | 5,439,000 | 7,837,000 | 7,695,000 | 12,860,000 | 3,538,000 | 184,000 | 37,706,000 |
| Industrial works | 3,235,000 | 4,773,000 | 1,983,000 | 12,062,000 | 3,810,000 | 2,784,000 | 695,000 | 29,342,000 |
| Buildings | 7,167,000 | 26,775,000 | 4,004,000 | 22,073,000 | 10,844,000 | 9,673,000 | 4,493,000 | 85,029,000 |
| Federal government | ..... | 241,000 | 1,216,000 | 2,292,000 | 532,000 | 1,406,000 | ..... | 5,687,000 |
| Miscellaneous | ..... | 671,000 | 75,000 | 1,719,000 | 18,384,000 | 2,620,000 | 4,718,000 | 28,187,000 |
| Total | $10,844,000 | $52,520,000 | $15,734,000 | $51,373,000 | $50,648,000 | $48,676,000 | $10,554,000 | $240,349,000 |

## Labor Rates and Conditions Throughout the Country

Increased production, rather than higher prices or more extensive use of credits, appears as the ruling factor in the maintenance of strength and confidence in industry and trade at the outset of the spring season.

The construction industry, particularly, has experienced only such slackening as caused by weather conditions, transportation shortage and scarcity of skilled labor, principally bricklayers and plasterers. Conditions, generally, have steadily improved during the winter so that it is difficult to cite an industry which is not operating close to capacity.

The consuming capacity of the country with the increased employment of workers at advanced wages in some industries, is greater now than at any time in the last two years.

The common labor rate for the nation as applied to pick and shovel men in construction operations, is placed at 50c. per hr. as against 49c. for the preceding month, according to *Engineering News-Record's* figures. Local building conditions are as follows:

**Atlanta**—Much building work planned ahead. Considerable difficulty experienced in getting materials owing to transportation shortage.

**Chicago**—Building Trades' Council signed agreement with Building Construction Employers' Association, recognizing principles of Landis Award for three years.

**Dallas**—Surplus of building trades mechanics not so great as in February.

**Denver**—Employment at 100 per cent. Applications pending for advance of $1 per day in building trades wage rates.

**Detroit**—No idle men in construction field. Wage rates remain unchanged.

**Kansas City**—Scarcity of bricklayers, hodcarriers and common laborers.

**Minneapolis** — Official wage scale shown in table, but rates averaging 10

per cent higher are being offered. Present basis will hold until June 1.

**Montreal**—Plenty of men, especially roofers, electrical workers, painters and plasterers.

clared unconstitutional. If this decision is sustained by the Court of Appeals it will curb residential building. Commercial and industrial construction, however, unaffected.

mechanics; shortage of men at steel mills.

**St. Louis**—New scale shown in table effective March 1. Carpenters and pile-drivers ask advance effective May 1.

CURRENT BUILDING TRADES WAGE RATES PER HOUR
(Higher rates indicated by +, decreases by—)

| Cities | Bricklayers | Carpenters | Hoisting Engineers | Hod Carriers | Pile Drivers | Structural Iron Workers | Common Labor |
|---|---|---|---|---|---|---|---|
| Atlanta | +$1.12½ | $0.70 | $0.70 | $0.30 | ..... | $0.65 | $0.30@.35 |
| Baltimore | 1.25 | .80@.90 | .80@1.00 | .87½ | $0.65 | .80@1.00 | .30@.45 |
| Birmingham | 1.00 | .75 | .50@1.00 | .15@.25 | ..... | 1.00 | .20@.25 |
| Boston | 1.25 | 1.00 | 90@1.00 | .80 | 1.00 | 1.00 | .60 |
| Cincinnati | 1.25 | 1.00 | 1.00 | .77½ | 1.00 | 1.00 | .40@.60 |
| Chicago | 1.10 | 1.00 | 1.10 | ..... | 1.10 | 1.05 | .72½ |
| Cleveland | +1.40 | +1.25 | +1.25 | +.87½ | +1.00 | +1.25 | +.87½ |
| Dallas | 1.37½ | 1.00 | 1.00 | .40 | .87½ | 1.00 | .30@.50 |
| Denver | 1.25 | 1.00 | 1.00 | .75@.81¼ | 1.00 | 1.03⅛ | .35@.55 |
| Detroit | 1.12½ | .80 | .80@.90 | .50@.60 | 1.00 | .60@.80 | .50 |
| Kansas City | 1.12½ | 1.00 | 1.00@1.25 | .65 | 1.00 | 1.00 | +.40@.75 |
| Los Angeles | 1.25 | 1.00 | 1.00 | .50@.62½ | ..... | 87½@1.00 | .50 |
| Minneapolis | 1.00 | .80 | .80 | .65 | ..... | .80 | .35@.50 |
| Montreal | .90 | .65 | .50 | .30 | .50 | .65 | .25 |
| New Orleans | 1.00 | .85 | .90 | .65 | .80 | 1.00 | .35@.40 |
| New York | 1.25 | 1.12½ | 1.25 | 87½ | 1.00 | 1.12½ | +.45@.70 |
| Pittsburgh | 1.30 | +1.20 | +1.12½ | .90 | ..... | 1.00 | .50 |
| St. Louis | +1.50 | 1.10 | 1.12½ | +1.00 | 1.12 | +1.25 | +.40@.67½ |
| San Francisco | 1.25 | 1.00 | 1.00 | .81¼ | 1.00 | 1.12½ | .50@.56¼ |
| Seattle | 1.12½ | .87½ | .87½@1.00 | 93¾ | 1.00 | .90@1.00 | .30@.70 |
| Philadelphia | +1.37½ | +1.12½ | +1.00 | .75@1.00 | +1.10 | +1.10 | +.50@.65 |

**New Orleans**—Labor working without contract under present scale of wages, effective until June 1.

**New York**—Tax exemption law de-

**Philadelphia**—Labor market critical. Contractors look for wage demands after May 1.

**Pittsburgh**—Enough building trades

Hoisting engineers demand higher rate after June 1.

**San Francisco**—Striking plasterers returned to work; construction active.

# Monthly Prices of Construction Materials

## *Ups and Downs of the Market*

**Pig Iron**—Prices continue to advance with increasing third-quarter buying movement. No. 2 foundry, basic and bessemer iron, $31 at Pittsburgh, including freight from valley; a rise of about $2 per ton since March 1.

**Railway Supplies**—Track materials in heavy demand and very firm. Standard spikes up 25c. at Pittsburgh mill; 30c. in St. Louis and 40c. per 100 lb., f.o.b. San Francisco. Track bolts and angle bars also higher.

**Pipe**—Wrought steel pipe discounts five points lower in St. Louis warehouses. Cast-iron pipe, 6 in., up $2 in St. Louis; $3 in San Francisco and Chicago and $1 per ton in New York, since last month. Rises due to higher pig iron. Sewer pipe advanced in eight out of twenty-one cities reporting to *Engineering News-Record*. Clay drain tile up $10 per M. lin.ft. in St. Louis.

**Road And Paving Materials**—Liquid asphalt, and road oil (45 per cent asphalt) 6c. and 5c. per gal., respectively; same price in effect one year ago. Asphalt, New York, $20 in package, against $19; $16 in bulk, compared with $15 per ton, one month ago. Wood blocks, 3½-in., up 10c. in Philadelphia, 15c. in New York and 53c. per sq.yd. in Minneapolis; 4-in., $1 higher in Kansas City.

**Sand Gravel and Crushed Stone**—Gravel up 25c. in New York and Seattle, 15c. in Atlanta and 10c. per cu.yd. in Philadelphia. Sand advanced 50c. in New Orleans, 25c. in Seattle and 20c. per cu.yd. in Philadelphia, during month. Rise due to increased demand and cost of production at source. Crushed stone rose 50c. in Dallas and 25c. per cu.yd. in Cleveland.

**Lime**—Hydrated lime advanced in St. Louis, Kansas City and Philadelphia, but declined slightly in Atlanta. Lump lime higher in Minneapolis and Philadelphia. Quotations unchanged in New York but tendency in direction of higher prices.

**Cement**—Mill rise of 5c. at Mitchell, Ind., Mason City, Ia. and La Salle, Ill.; 15c. at Wyandotte, Mich., and 20c. per bbl. at Alpena, Mich., during month. Following advanced at mill, prices rose 10c., f.o.b. Birmingham, 15c. in Atlanta and 10c. per bbl., delivered in New York.

**Structural Steel**—Reinforcing bar mills withdrawing from second quarter tonnage obligations; demand steadily increasing and prices showing tendency to advance. For reasonably early deliveries market not below $2.50 per 100 lb.; deferred shipments, $2.75. Shapes at $2.45 base, not for early delivery; $2.50 minimum on sixty-day deliveries. Plates, $2.45, booked for first half; $2.50 minimum on early deliveries, with maximum at $2.75 per 100 lb.

**Brick and Hollow Tile**—Common brick advanced 50c. in Montreal, 60c. in Dallas, $1 in Atlanta, $1.50 in New Orleans, $2 in Kansas City and St. Louis, and $2.50 per M. in Detroit. San Francisco reported drop of 50c. per M. during month. Hollow tile advanced in New York, St. Louis, Kansas City, Cleveland, Atlanta and Detroit; no declines reported.

**Lumber**—Mills sold up for weeks ahead; declining further business. Prices holding firm with stronger tone in most cities. Yellow-pine timbers, base sizes, up $2 in Philadelphia and Kansas City; $3 in Birmingham and Atlanta. Douglas fir advanced $1 in Minneapolis and Seattle; $2 per M. ft. in Philadelphia and Detroit. Hemlock and spruce higher. Denver reports slight drop in structural timbers.

**Scrap**—Iron and steel scrap weaker, due to recent heavy buying at mills. Price, however, higher than month ago.

**Explosives**—Slight rise in Philadelphia; lower in Birmingham. No other changes reported.

**Linseed Oil**—Raw oil up 12c. in New York and 8c. per gal. in Chicago, since last month. Tendency higher throughout the country, due to heavy demand and shortage of seed.

Price advances since last month are indicated by **heavy type**; declines by *italics*

**PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:**

| | Apr. 5 | One Year Ago |
|---|---|---|
| CINCINNATI | | |
| No. 2 Southern (silicon 2.25 @ 2.75) | **$31.55** | $20.50 |
| Northern Basic | **31.27** | 21.02 |
| Southern Ohio No. 2 (silicon 1.75 @ 2.25) | **33.27** | 21.54 |
| NEW YORK, tidewater delivery | | |
| Southern No. 2 (silicon 2.25 @ 2.75) | **34.44** | 28.16 |
| BIRMINGHAM | | |
| No. 2 Foundry (silicon 2.25 @ 2.75) | **27.00** | 15.78 |
| PHILADELPHIA | | |
| Eastern Pa., No. 2X, (2.25@2.75 sil.) | **33.76** | 21.34 |
| Virginia No. 2 (silicon 2.25 @ 2.75) | **34.17** | 27.74 |
| Basic | **31.00** | 21.00 |
| Gray Forge | **31.00** | 20.50 |
| CHICAGO | | |
| No. 2 Foundry Local (silicon 1.75 @ 2.25) | **32.00** | 20.00 |
| No. 2 Foundry Southern (silicon 2.25 @ 2.75) | **33.01** | 21.67 |
| PITTSBURGH, including freight charge from the Valley | | |
| No. 2 Foundry Valley (silicon 1.75 @ 2.25) | **31.00** | 19.00 |
| Basic | **31.00** | 18.00 |
| Bessemer | **31.00** | 19.50 |

## RAILWAY SUPPLIES

**STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:**

| | Pittsburgh | | | | |
|---|---|---|---|---|---|
| | Apr. 5 | One Year Ago | Birmingham | Chicago | St. Louis |
| Standard bessemer rails | $43.00 | $40.00 | ..... | $43.00 | 43.00 |
| Standard openhearth rails | 43.00 | 40.00 | $43.00 | 43.00 | 43.00 |
| Light rails, 8 to 10 lb. | 43@45 | 28@29 | 2.00* | 43.00 | 43.00 |
| Light rails, 12 to 14 lb. | 43@45 | 28@29 | 2.00* | 43.00 | 43.00 |
| Light rails, 25 to 45 lb. | 43@45 | 28@29 | 2.00* | 43.00 | 43.00 |
| Rerolled Rails | **42@45** | 1.45@1.50* | ..... | ..... | ..... |

*Per 100 lb.

**RAILWAY TIES—For fair-sized orders, the following prices per tie hold:**

| | 6 In. x 8 In. by 8½ Ft. | 7 In. x 9 In. by 8½ Ft. |
|---|---|---|
| Chicago, White Oak | $1.50 | $1.65 |
| Chicago, Hardwood and Red Oak | 1.25 | 1.40 |
| Chicago....Empty Cell Creosoting (add'l) | .45 | .50 |
| San Francisco..... Green Douglas Fir | .84 | 1.14 |
| San Francisco, Empty Cell Creosoted, Douglas Fir | 1.70 | 2.25 |
| St. Louis, White Oak | 1.30 | 1.55 |
| St. Louis (creosoted) (zinc treated) | 1.70 | 2.05 |
| St. Louis, Red Oak, plain | 1.15 | 1.40 |
| St. Louis, Sap pine-cypress | 1.05 | 1.30 |

**TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:**

| | Pittsburgh | | | | | |
|---|---|---|---|---|---|---|
| | Apr. 5 | One Year Ago | Chicago | St. Louis | San Francisco | Birmingham |
| Standard spikes, ⅝-in. and larger | **$3.15** | $2.00@2.35 | $3.00 | **$3.90** | **$4.85** | $3.29 |
| Track bolts | **4.00** @4.50 | 2.90@3.00 | 4.00 | **5.00** | **5.85** | 4.29 |
| Standard section angle bars | 2.75 | 1.40@1.50 | 2.75 | **3.75** | 4.10 | 2.94 |

## PIPE

**WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:**

BUTT WELD

| Inches | Steel Black | Steel Galv. | Inches | Iron Black | Iron Galv. |
|---|---|---|---|---|---|
| 1 to 3 | 64 | 52½ | ⅜ to 1¼ | 30 | 13 |

LAP WELD

| | | | | | |
|---|---|---|---|---|---|
| 2 | 57 | 45½ | 2 | 23 | 7 |
| 2½ to 6 | 61 | 49½ | 2½ to 4 | 26 | 11 |
| 7 to 8 | 58 | 45½ | 4½ to 6 | 28 | 13 |
| 9 to 12 | 57 | 44½ | 7 to 12 | 26 | 11 |

BUTT WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 1 to 1¼ | 62 | 51½ | ⅜ to 1¼ | 30 | 14 |
| 2 to 3 | 63 | 52½ | | | |

LAP WELD, EXTRA STRONG, PLAIN ENDS

| | | | | | |
|---|---|---|---|---|---|
| 2 | 55 | 44½ | 2 | 23 | 9 |
| 2½ to 4 | 59 | 48½ | 2½ to 4 | 29 | 15 |
| 4½ to 6 | 58 | 47½ | 4½ to 6 | 28 | 14 |
| 7 to 8 | 54 | 41½ | 7 to 8 | 21 | 7 |
| 9 to 12 | 48 | 35½ | 6 to 12 | 16 | 2 |

**STEEL PIPE**—From warehouses at the places named the following discounts hold for steel pipe:

| | Black | | | Galvanized | | |
|---|---|---|---|---|---|---|
| | New York | Chicago | St. Louis | New York | Chicago | St. Louis |
| 1 to 3 in. butt welded | 54% | 62½% | **52%** | 41% | 48½% | **39%** |
| 2½ to 6 in. lap welded | 51% | 59½% | **49%** | 38% | 45½% | **36%** |

Malleable fittings, Classes B and C, banded, from New York stock sell at list plus 5%. Cast iron, standard sizes, 25% off.

**CAST-IRON PIPE**—The following are prices per net ton for carload lots:

| | Birmingham Mill | New York Apr. 5 | New York One Year Ago | Chicago | St. Louis | San Francisco |
|---|---|---|---|---|---|---|
| 4 in. | **$52.00** | **$62.00** | $50.30 | **$61.20** | **$56.60** | **$64.00** |
| 6 in. and over | **48.00** | **57.50** | 47.30 | **57.20** | **52.60** | **60.00** |

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

**CLAY DRAIN TILE**—The following prices are per 1000 lin.ft.:

| Size, In. | New York Apr. 5 | New York One Year Ago | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 3 | $45.00 | $40.00 | **$50.00** | $62.50 | ..... | $73.00 |
| 4 | 55.00 | 50.00 | **50.00** | 75.00 | $76.50 | 83.00 |
| 5 | 80.00 | 80.00 | ..... | 100.00 | 97.75 | 108.00 |
| 6 | 105.00 | 100.00 | **85.00** | 175.00 | 127.50 | 133.00 |
| 8 | 170.00 | 150.00 | **195.00** | 187.50 | 212.50 | 199.00 |

**SEWER PIPE**—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

| Size, In | New York Delivered | Pittsburgh | Birmingham | St. Louis | Chicago | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| 3 | ..... | **$0.114** | ..... | ..... | $0.15 | **$0.12** | ..... |
| 4 | ..... | **.114** | $0.10 | **$0.1175** | .15 | .15 | $0.12 |
| 5 | ..... | **.171** | .125 | ..... | .23 | .18 | .16 |
| 6 | **$0.24** | **.171** | .150 | **.1645** | .23 | .21 | .1855 |
| 8 | **.38** | **.266** | **.25** | **.26** | .35 | .30 | .30 |
| 10 | **.57** | **.399** | **.325** | **.364** | .53 | .42 | .441 |
| 12 | **.72** | **.513** | **.425** | **.468** | .68 | .54 | .567 |
| 15 | **1.13†** | **.684** | **.625** | **.78†** | .90 | .90 | .819 |
| 18 | **1.65†** | **.95** | **.85** | **1.092†** | 1.25 | 1.32 | 1.071 |
| 20 | **1.98†** | **1.14** | **1.125** | ..... | 1.50 | ..... | ..... |
| 22 | **2.64†** | **1.52** | **1.375** | **1.456†** | 2.00 | ..... | 1.44 |
| 24 | **2.97†** | **1.71** | **1.625** | **1.872†** | 2.25 | 2.16 | 1.89 |
| 27 | **4.81†** | **2.99** | ..... | **2.95†** | 4.69† | 3.00 | 3.34 |
| 30 | **5.33†** | **3.312** | ..... | **3.65†** | 5.94† | 3.60 | 4.06 |
| 33 | **6.93†** | **4.41** | ..... | **4.45†** | 6.88† | ..... | 4.99 |
| 36 | **7.91†** | **5.0225** | ..... | **4.80†** | 7.50† | ..... | 5.42 |
| | 3 | 5 | 8 | 12 | 24 | | 36 |
| Boston | $0.125 | $0.19 | $0.30 | $0.578 | $1.90† | | $5.75† |
| Minneapolis | ..... | ..... | .40 | .72 | 2.55 | | 5.66† |
| Denver | .135* | .18* | .27 | .47 | 1.70 | | ..... |
| Seattle | .13 | ..... | .36 | .72† | 2.60† | | ..... |
| Los Angeles | .11 | .165 | .275 | .495 | 1.65 | | ..... |
| New Orleans | **.112*** | **.168*** | **.28** | **.476** | **1.182†** | | ..... |
| Cincinnati | .14 | .215 | .34 | .66 | 2.25 | | 4.92† |
| Atlanta | **.112*** | **.168*** | **.28** | **.476** | **1.82** | | ..... |
| Montreal, *delivered* | .68‡ | .45† | .70 | 1.35 | 4.50† | | ..... |
| Detroit | **.117** | **.1755** | **.273** | **.5265** | **2.34†** | | 6.15† |
| Baltimore | .12 | .18 | .28 | .54 | 1.80 | | 5.2275 |
| Kansas City, Mo. | .135* | .19* | *.30** | *.52* | *2.09* | | 3.95 |
| Philadelphia | **.124** | **.1871** | **.286** | **.545** | **1.89†** | | **4.37†** |

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

## ROAD AND PAVING MATERIALS

**ROAD OILS**—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

| | Apr. 5 | One Year Ago |
|---|---|---|
| New York, 45% asphalt.....(at terminal) | *$0.05* | $0.05 |
| New York, 65% asphalt.....(at terminal) | *.05* | .05 |
| New York, binder.....(at terminal) | *.0575* | .055 |
| New York, flux.....(at terminal) | *.055* | .05 |
| New York, liquid asphalt....(at terminal) | *.06* | .06 |
| St. Louis, 50@60% asphalt | **.06** | .035 |
| St. Louis, 40@50% asphalt | .055 | ..... |
| Chicago, 40–50% asphalt | .0525 | .05 |
| Chicago, 60–70% asphalt | .055 | .0525 |
| Dallas, 45% asphalt | .04 | .10 |
| Dallas, 55% asphalt | .048 | .13 |
| Dallas, binder | .053 | .15 |
| San Francisco, binder, per ton | 9.50* | 13.00* |

* F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

**ASPHALT**—Price per ton in packages (350-lb. bbl., or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

| | Package | Bulk |
|---|---|---|
| New York (*Mexican*) | *$19.00* | *$15.00* |
| Boston (*Mexican*) | 20.00 | 16.50 |
| Chicago (*Stanolind*) | 22.25 | 16.00 |
| San Francisco, *f.o.b. refinery*, Oleum, Cal. | 17.00* | 11.00* |
| Dallas, (*Texas*) | 23.00 | 15.00 |
| Seattle, "*D*" *grade* (*California*) | 24.75 | 20.50† |
| Denver (*California*) | 24.00 | |
| Minneapolis *f.o.b. Twin Cities* (*Stanolind*) | 25.45 | 19.10 |
| St. Louis (*Mexican*) | *22.50* | *18.50* |
| Baltimore (*Standard Oil*) | *19.00* | *14.50* |
| Montreal (*Imperial*) | *22.00* | *17.00* |
| Atlanta (*Mexican*) | 26.00 | 23.50 |
| Detroit (*Mexican*) | *22.47* | *18.40* |
| Cincinnati (*Kentucky Rock*) | 22.50 | 19.50 |
| Maurer, N. J. (*Bermudez*) | 28.00 | 26.00 |
| Maurer, N. J. (*Mexican*) | 21.50 | 18.50 |
| Philadelphia (*Mexican*) | *19.00* | *15.00* |
| Kansas City (*Texas*) | 27.50 | 25.50 |

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums; 200 to 300 gal. to the ton.

**PAVING STONE—**

| | | |
|---|---|---|
| New York (grade I) | 5-in. granite, 30 blocks per sq.yd. | $134.50 per M. |
| Chicago | About 4x8x4 dressed | 3.60 per sq.yd. |
| | About 4x8x4 common | 3.15 per sq.yd. |
| San Francisco | Basalt block 4x7x8 | 70.00 per M |
| Boston | 5-in. granite, 28 blocks per sq.yd. | 3.15@3.20 per sq.yd. |
| Atlanta | Granite | 2.66 per sq.yd. |
| Detroit | 5-in. Granite | 3.00 per sq.yd. |
| | 4-in. Granite | 3.25 per sq.yd. |
| Baltimore | Granite | 2.85 per sq.yd. |
| Montreal | Granite | 100.00 per M |
| New Orleans | Granite, 4 x 8 x 4 | 3.25 per sq.yd. |
| Cincinnati | Granite | 135.00 per M. |
| St. Louis | 4x8x4 dressed | 3.10 per sq.yd. |
| | 4x8x4 common | 2.90 per sq.yd. |
| Kansas City | Granite | *3.20* per sq.yd. |
| Philadelphia | Granite | 135.00 per M. |

**FLAGGING—**

| | | |
|---|---|---|
| New York | Bronx, 4 ft wide | $0.22 per square |
| | Manhattan, 4 ft. wide | .22 per square |
| | Queens, 5 ft. wide | .24 per square |
| | 6x24-in. cross-walk | 1.00 lin.ft. |
| Chicago | 18 in. wide | .99 lin.ft. |

**CURBING**—*New York*: Bluestone per lin.ft., f.o.b. barge New York, 5 x 16 in., 75c.; 5 x 20 in., Queens, 85c. *St. Louis*: Class "A" straight, delivered, 5 x 16 in., $1.40 per lin.ft. *Chicago*: 5 x 18 in., delivered, $3 per lin.ft.

**WOOD BLOCK PAVING—**

| | Size of Block | Treatment | Per Sq.Yd. |
|---|---|---|---|
| New York (*delivered*) | 3 | 16 | $2.63 |
| New York (*delivered*) | 3½ | 16 | 3.19 |
| Boston | 3½ | 16 | 2.35 |
| Chicago | 4 | 16 | 3.00@3.25 |
| Chicago | 3½ | 16 | 2.50 |
| St. Louis | 3½ | 16 | 2.75 |
| St. Louis | 4 | 16 | 3.10 |
| Seattle | 4 | 16 | Off market |
| Minneapolis | 3½ | 16 | 2.62 |
| Atlanta | 3½ | 16 | *2.00* |
| New Orleans | 3 | 16 | 2.10 |
| New Orleans | 3½ | 16 | 2.30 |
| New Orleans | 4 | 16 | 2.60 |
| Dallas | 4 | 18 | 3.90 |
| Baltimore | 3½ | 16 | none used |
| Montreal | 4 | 16 | 4.50 |
| Detroit | 3 | 16 | 2.84 |
| Detroit | 4 | 16 | 3.00 |
| Cincinnati | 4 | 16 | 2.38 |
| Kansas City | 4 | 16 | 3.65 |
| Philadelphia | 3½ | 16 | 2.60 |

# CONSTRUCTION MATERIALS

**SAND AND GRAVEL**—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

| | Gravel 1½ In. Apr. 5 | Gravel 1½ In. One Year Ago | Gravel ¾ In. Apr. 5 | Gravel ¾ In. One Year Ago | Sand Apr. 5 | Sand One Year Ago |
|---|---|---|---|---|---|---|
| New York | $2.25 | $1.75 | $2.25 | $1.75 | $1.00 | $1.00 |
| Denver | 1.90 | 2.50 | 1.90 | 2.50 | 1.00 | 1.10 |
| Chicago | 2.25 | 2.00 | 2.25 | 2.00 | 2.25 | 2.00 |
| St. Louis | 1.45 | 1.25† | 1.65 | 1.30† | 1.45 | 1.10† |
| Seattle | 1.25 | 1.50 | 1.25 | 1.50 | 1.25 | 1.50 |
| Dallas | 2.25 | 2.25 | 2.25 | 2.25 | 1.87½ | 2.25 |
| Minneapolis | 1.75* | 1.50 | 1.75* | 1.50 | 1.00 | 1.00* |
| Cincinnati | 1.50† | 1.87½ | 1.50† | 1.87½ | 1.25† | 1.43 |
| San Francisco | 2.15 | 2.25 | 2.15 | 2.25 | 1.50 | 1.50 |
| Boston | 1.40† | 2.40 | 1.40† | 2.40 | 1.10† | 1.65 |
| New Orleans | 2.85 | 2.08½ | 2.85 | 2.08½ | 1.85 | 1.35 |
| Los Angeles | 0.75* | 1.50† | 0.85* | 1.50† | 0.50†* | 1.35† |
| Atlanta | 1.90† | 1.85† | 1.90† | 1.85† | 1.24† | 1.15† |
| Detroit | 2.25 | 2.00 | 2.25 | 2.00 | 2.00 | 2.00 |
| Baltimore | 1.86 | 1.40 | 2.06 | 1.60 | 0.70† | 2.00 |
| Montreal | 1.25† | 1.25† | 1.50† | 1.50† | 1.25† | 1.25† |
| Birmingham (Crushed slag used instead of gravel) | | | | | 1.25† | 1.25† |
| Philadelphia | 1.85 | 1.50 | 1.95 | 1.55 | 1.90 | 1.60 |
| Kansas City | 1.60† | 2.00 | 1.60† | 2.00 | 0.66* | 1.20 |

New York—Grit, $1.75 per cu. yd.; ready mixed, $2.25

Los Angeles—Freight from quarry, 70c. per ton, and is included in above price.

* At pit.

† Per ton.

**CRUSHED STONE**—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

| | 1½ In. Apr. 5 | 1½ In. One Year Ago | ¾ In. Apr. 5 | ¾ In. One Year Ago |
|---|---|---|---|---|
| New York | $1.65 | $1.65 | $1.75 | $1.75 |
| Chicago | 2.25 | 1.60 | 2.25 | 1.60 |
| St. Louis *delivered* | 2.00 | 1.65 | 2.10 | 1.65 |
| Dallas | 2.50 | 2.73 | 2.50 | 2.73 |
| San Francisco | 2.15 | 2.25 | 2.15 | 2.25 |
| Boston, *delivered* | 1.85* | 3.00* | 1.85* | 3.00* |
| Minneapolis, *et plant* | 2.00 | 2.00 | 2.25 | 2.25 |
| Kansas City | 1.50 | 2.10 | 1.50 | 2.10 |
| Denver | 3.50 | 3.50 | 3.50 | 3.50 |
| Seattle *delivered* | 3.00 | 3.00 | 3.00 | 3.00 |
| Atlanta | 2.00* | 1.90* | 2.00* | 1.90* |
| Cincinnati | 1.75* | 1.75 | 2.25* | 1.75 |
| Los Angeles | 1.00 | 1.75* | 1.00 | 1.85* |
| Detroit | *1.60*@1.90* | 1.90* | *1.60*@1.90* | 1.90* |
| Baltimore | 2.37 | 1.75* | 2.43 | 1.65* |
| Montreal | 1.80* | 2.00* | 1.90* | 2.10* |
| Birmingham *delivered* | 3.20 | 3.20 | 3.10 | 3.10 |
| Phildelphia | 1.80* | 1.70* | 1.65* | 1.55* |
| Pittsburgh | 2.85 | .... | 2.85 | .... |
| Cleveland | 3.25* | .... | 3.25* | .... |

*Per ton.

**CRUSHED SLAG**—Price of crushed slag in carload lots, per net ton, at plants:

| | 1½-In. | ¾-In. | Roofing | Sand |
|---|---|---|---|---|
| Youngstown District | $1.30 | $1.30 | $2.00 | $1.30 |
| Steubenville District | 1.40 | 1.40 | 2.00 | 1.40 |
| Ironton District | 1.40 | 1.40 | 2.00 | 1.40 |
| East Canaan, Conn. | 1.25 | 1.35 | 4.00 | 1.00 |
| Easton, Catasaqua, Pa. | 1.00 | 1.00 | 2.00 | 0.90 |
| Birmingham, Ala. | 1.00 | 1.00 | 1.00 | 1.00 |
| Buffalo, N. Y., and Erie, Pa. | 1.25 | 1.25 | 2.25 | 1.25 |
| Cleveland, Ohio | 1.20 | 1.20 | .... | 1.00 |
| Eastern Pennsylvania and Northern New Jersey | 1.20 | 1.20 | 2.00 | 1.20 |
| Western Pennsylvania | 1.25 | 1.25 | 2.00 | 1.25 |

**LIME**—Warehouse prices:

| | Hydrated, per Ton Finishing | Hydrated, per Ton Common | Lump, per Barrel Finishing | Lump, per Barrel Common |
|---|---|---|---|---|
| New York | $16.80@$17.10 | $13.10 | $3.75* | $3.00@$3.25* |
| Chicago | 20.00 | 20.00 | 1.50† | 1.50† |
| St. Louis | 23.20 | 20.00 | 18.75‡ | 18.75‡ |
| Boston | 21.00 | 14.50 | 4.40* | 3.12* |
| Dallas | 22.50 | .... | .... | 2.50† |
| Cincinnati | 16.80 | 13.30 | .... | 10.75‡ |
| San Francisco | 22.00 | 16.00 | .... | 1.75† |
| Minneapolis | 25.50 | 21.00 (white) | 1.60† | 1.25† |
| Denver | 24.00 | .... | .... | 2.70† |
| Detroit | 19.50 | 17.50 | .... | 18.25‡ |
| Seattle *paper sacks* | 24.00 | ..... | 2.80† | .... |
| Los Angeles | .... | .... | .... | 3.00* |
| Baltimore | 22.00 | 16.25 | .... | ..... |
| Montreal | .... | 21.00 | .... | 11.00‡ |
| Atlanta | 23.00 | *14.50* | 2.25† | 1.35† |
| New Orleans | .... | 17.25 | 2.40† | .... |
| Philadelphia | 16.00 | 15.00 | 13.50‡ | 12.50‡ |
| Kansas City | 25.60 | 24.00 | ..... | 2.40* |

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is $1.70, Sheboygan $1.60. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

**NATURAL CEMENT**—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

| | Apr. 5 | One Year Ago |
|---|---|---|
| Minneapolis (Rosendale) | $2.80 | $2.80 |
| Kansas City (Ft. Scott) | 1.50 | 1.60 |
| Atlanta (Magnolia) | 11.00 per ton | 11.00 per ton |
| Cincinnati (Utica) | 1.72 | 1.77 |
| Boston (Rosendale) | 2.60 | 0.80 per bag |
| St. Louis (Carney) | 1.75 | .... |

**PORTLAND CEMENT**—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

| | Apr. 5 | One Month Ago | One Year Ago |
|---|---|---|---|
| New York, del. by truck | $2.70@2.80 | $2.60@2.70 | $2.40 |
| New York, alongside dock to dealers | 2.30 | 2.30 | 2.30 |
| Jersey City | 2.48 | 2.48 | 2.12 |
| Boston | 2.75 | 2.75 | 2.50 |
| Chicago | 2.20 | 2.20 | 1.97 |
| Pittsburgh | 2.24 | 2.24 | 2.02 |
| Cleveland | 2.46 | 2.46 | 2.26 |
| Detroit | 2.47 | 2.47 | 2.17 |
| Indianapolis | 2.41 | 2.41 | 2.21 |
| Toledo | 2.48 | 2.48 | 2.20 |
| Milwaukee | 2.37 | 2.37 | 2.18 |
| Duluth | 2.14 | 2.14 | 1.94 |
| Peoria | 2.41 | 2.41 | 2.08 |
| Cedar Rapids | 2.48 | 2.48 | 2.21 |
| Davenport | 2.43 | 2.43 | 2.16 |
| St. Louis | 2.35 | 2.35 | 2.20 |
| San Francisco | 2.71 | 2.71 | 2.73 |
| New Orleans | 3.30 | 3.30 | 3.00 |
| Minneapolis | 2.39 | 2.39 | 2.24 |
| Denver | 2.85 | 2.85 | 2.90 |
| Seattle | 2.90 | 2.90 | 2.94 |
| Dallas | 2.25 | 2.25 | 2.25 |
| Atlanta | 2.90 | 2.75 | 2.39 |
| Cincinnati | 2.54 | 2.54 | 2.35 |
| Los Angeles | 3.40 | .... | 3.30 |
| Baltimore | 2.61 | 2.61 | 2.50 |
| Birmingham | 2.50 | 2.40 | 2.27 |
| Kansas City | *2.42* | 2.45 | 2.40 |
| Montreal (*delivered*) | 2.88 | 2.88 | 2.40 |
| Philadelphia | 2.41 | 2.41 | 2.21 |
| St. Paul | 2.39 | 2.39 | 2.24 |

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags, to contractors:

| | | | |
|---|---|---|---|
| Buffington, Ind. | $1.95 | La Salle, Ill. | $2.10 |
| Universal, Pa. | 2.00 | Hudson, N. Y. | 2.20 |
| Steelton, Minn. | 1.95 | Leeds, Ala. | 2.20 |
| Fordwick, Va. | 2.20 | Hannibal, Mo. | 2.10 |
| Mitchell, Ind. | 2.10 | Lehigh Valley District | 2.10 |
| Iola, Kan. | 2.10 | Wyandotte, Mich. | 2.35* |
| Mason City, Ia. | 2.10 | Alpena, Mich. | 2.20† |

*Mar. 1, $2.20 per bbl. †Mar. 1, $2 per bbl.

**TRIANGLE MESH**—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

| Style Number | Weight in Pounds per 100 sq.ft. | Pittsburgh Mill | Chicago Mill | Warehouse New York | St. Louis | Dallas | San Francisco |
|---|---|---|---|---|---|---|---|
| 032 | 22 | $0.89 | $0.99 | $1.24 | $0.98 | $1.00 | $1.08 |
| 049 | 28 | 1.13 | 1.28 | 1.58 | 1.25 | 1.33 | 1.41 |
| 068 | 35 | 1.38 | 1.56 | 1.94 | 1.53 | 1.61 | 1.72 |
| 093 | 45 | 1.78 | 2.00 | 2.50 | 1.97 | 1.935 | 2.19 |
| 126 | 57 | 2.19 | 2.47 | 3.09 | 2.44 | 2.451 | 2.71 |
| 153 | 68 | 2.62 | 2.95 | 3.60 | 2.91 | 3.05 | ..... |
| 180 | 78 | 3.00 | 3.39 | 4.22 | 3.34 | 3.351 | ..... |
| 245 | 103 | 3.97 | 4.47 | 5.60 | 4.41 | 4.427 | ..... |
| 287 | 119 | 4.58 | 5.16 | 6.44 | 5.09 | 5.115 | 5.68 |
| 336 | 138 | 5.31 | 5.99 | 7.39 | 5.90 | 5.934 | ..... |
| 395 | 160 | 6.16 | 6.94 | 8.67 | 6.85 | 6.88 | ..... |
| | | PAVING | | | | | |
| 036P | 17 | $0.68 | $0.77 | $0.95 | $0.75 | $0.731 | ..... |
| 053P | 24 | .96 | 1.08 | 1.35 | 1.06 | 1.032 | ..... |
| 072P | 31 | 1.21 | 1.37 | 1.71 | 1.34 | 1.333 | ..... |
| 097P | 40 | 1.56 | 1.76 | 2.20 | 1.73 | 1.84 | ..... |
| 049R | 24 | .96 | 1.08 | ..... | 1.06 | 1.032 | ..... |
| 067R | 31 | 1.21 | 1.37 | ..... | 1.34 | 1.333 | ..... |
| 089R | 40 | 1.56 | 1.76 | ..... | 1.73 | 1.84 | ..... |

In rolls, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in. wide x 150 ft. long, or 600 sq. ft.

**EXPANDED METAL LATH**—Prices in carload lots per 100 yd. for painted are as follows:

| Gage | Weight | *New York | Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|
| 27Dia. | 2.3 | $22.00 | $20.39 | $20.72 | $21.43 | $25.50 |
| 26 " | 2.5 | 22.00 | 21.93 | 22.39 | 20.78 | 27.58 |
| 25 " | 3.0 | 22.00 | 24.45 | 24.93 | ..... | 30.71 |
| 24 " | 3.4 | 24.00 | 26.33 | 27.10 | 24.28 | 33.16 |
| 22 " | 4.33 | 27.00 | 31.06 | 32.27 | ..... | 35.10 |

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

**BARS, CONCRETE REINFORCING**—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Warehouse, Uncut

| Inches | Pittsburgh Mill | Birmingham Mill | New York | Chicago | St. Louis | Dallas | San Francisco |
|---|---|---|---|---|---|---|---|
| ½ and larger | $2.00 | $2.35 | $3.34 | $3.22½ | $3.25 | $3.15 | $3.40 |
| ⅝ | 2.05 | 2.45 | 3.39 | 3.27½ | 3.30 | 3.20 | 3.45 |
| ¾ | 2.10 | 2.55 | 3.44 | 3.32½ | 3.35 | 3.25 | 3.50 |
| ⅞ | 2.25 | 2.60 | 3.49 | 3.47½ | 3.50 | 3.40 | 3.65 |
| 1 | 2.50 | 2.65 | 3.84 | 3.72½ | 3.70 | 3.65 | 3.90 |

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

| | Chicago | St. Louis | Dallas | | Chicago | St. Louis | Dallas |
|---|---|---|---|---|---|---|---|
| ½ and larger | $2.50 | $2.95 | $2.85 | ¾ | $2.75 | $3.20 | $3.10 |
| ⅝ in. | 2.55 | 3.00 | *2.90 | 1 | 3.00 | 3.45 | 3.35 |
| ¾ | 2.60 | 3.05 | 2.95 | ..... | ..... | ..... | .... |

**BRICK**—Contractors price per 1,000 in cargo or carload lots is as follows:

| | Common Apr. 5 | Common One Month Ago | Common One Year Ago | Paving Block 3-inch* | Paving Block 4-inch* |
|---|---|---|---|---|---|
| New York (del.) | $23.50 | $23.50 | $19.40@19.90 | $46.50 | $54.00 |
| New York (at dock) | 20.00 | 20.00 | 16@16.50 | ..... | ..... |
| Chicago | 11.00 | 11.00 | 11.00 | 34.00 | 42.00 |
| St. Louis, salmon | 15@17 | 15.00 | 16.00 | 38.50 | 40@42 |
| Denver, salmon | 12.00 | 12.00 | 12.00 | ..... | ..... |
| Dallas | 11.60 | 11.00 | 11.15 | 33.00 | ..... |
| San Francisco | 15.00 | 15.50 | 15.00 | ..... | ..... |
| Los Angeles (del.) | 15.00 | ..... | 15.00 | (not used) | |
| Boston | 20.00 | 20.00 | 16.00 | 48.25 | 56.00 |
| Minneapolis (del.) | 17@19 | 17@19 | 15.00 | ..... | ..... |
| Kansas City | 16.50 | 14.50 | 14.50 | ..... | ..... |
| Seattle | 13.00 | 13.00 | 14.00 | 50.00 | ..... |
| Cincinnati | 18.00 | 18.00 | 15.00 | 43.00 | 43.00 |
| Montreal | 16.50 | 16.00 | 16.00 | 100.00‡ | 68.00 |
| Detroit (del.) | 20.00 | 16.50@17.50 | 16.50 | 38.50 | 41.50 |
| Baltimore (del.) | 19.20 | 19.20 | 20.00 | 40.00 | 45.00 |
| Atlanta | 13.00 | 12.00 | 9.00 | 39.00 | ..... |
| New Orleans | 17.25 | 15.75 | 12.50 | ..... | ..... |
| Birmingham | 12.50 | 12.50 | 9.50 | ..... | ..... |
| Philadelphia | 19@25 | 19@25 | 16.00 | 40.00 | 48.00 |
| Pittsburgh (del.) | 16.00 | 16.00 | ..... | ..... | ..... |
| Cleveland | 16.00 | 16.00 | ..... | ..... | ..... |

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡Imported.

**HOLLOW TILE**—Price per block in carload lots to contractor for hollow building tile.

| | New York Apr. 5 on Trucks* | New York One Year Ago | Chicago | Philadelphia | St. Louis | San Francisco | Perth Amboy N. J., Factory* |
|---|---|---|---|---|---|---|---|
| 4x12x12 | $0.1314 | $0.1112 | $0.0674 | $0.125 | $0.09 | $0.108 | ..... |
| 6x12x12 | .1971 | .1667 | .0926 | ..... | .118 | .156 | ..... |
| 8x12x12 | .2463 | .2084 | .1263 | .19 | .16 | .244 | $0.2362 |
| 10x12x12 | ..... | ..... | .1621 | ..... | .188 | ..... | .2905 |
| 12x12x12 | ..... | ..... | .1853 | ..... | .232 | ..... | .3777 |

* 5 per. off for cash.

| | 4x12x12 | 8x12x12 | 12x12x12 |
|---|---|---|---|
| Boston | $0.11 | $0.21 | ..... |
| Minneapolis (f.o.b. cars) | .736 | .12125 | $0.214 |
| Minneapolis (delivered) | .0836 | .1369 | .239 |
| Cincinnati | .0859 | .1611 | .... |
| Kansas City | .083 | .1455 | ..... |
| Denver | .065 | .123 | .188 |
| Seattle (delivered) | .11 | .25 | .36 |
| Los Angeles factory | .10 | .175 | ..... |
| New Orleans | .12 | .23 | .36 |
| Detroit (delivered) | .101 | .1895 | .27 |
| Montreal | .115 | .225 | .30 |
| Baltimore | .10 | .215 | ..... |
| Atlanta | .0893 | .1674 | ..... |
| Dallas | .115 | ..... | ..... |
| Birmingham | .11 | .18 | ..... |
| Pittsburgh (delivered) | .068 | .128 | .179 |
| Cleveland | .09 | .172 | ..... |

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

**STRUCTURAL MATERIAL**—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at places named:

| | Pittsburgh Mill | Birmingham Mill | Warehouse New York | Dallas | St. Louis | Chicago | San Francisco |
|---|---|---|---|---|---|---|---|
| Beams, 3 to 15 in. | 2.45@2.75 | $2.40 | 3.44 | 4.50 | 3.35 | 3.20 | 3.60 |
| Channels, 3 to 15 in. | 2.45@2.75 | 2.40 | 3.44 | 4.50 | 3.35 | 3.20 | 3.60 |
| Angles, 3 to 16 in., ¼ in. thick | 2.45@2.75 | 2.40 | 3.44 | 4.50 | 3.35 | 3.20 | 3.60 |
| Tees, 3 in. and larger | 2.45@2.75 | 2.40 | 3.44 | 4.50 | 3.35 | 3.20 | 3.60 |
| Plates, ¼ in. thick and heavier | 2.45@2.75 | 2.40 | 3.44 | 4.60 | 3.35 | 3.20 | 3.60 |

**RIVETS**—The following quotations are per 100 lb.:

STRUCTURAL

| | Pittsburgh Mill | New York Apr. 5 | New York One Yr. Ago | Warehouse Chicago | St. Louis | San Francisco | Dallas |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | $3.25@3.50 | $4.00 | $3.35 | $3.75 | $3.90 | $4.75 | $5.25 |

CONE HEAD BOILER

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| ½ in. and larger | $3.35@3.60 | 4.10 | 3.45 | 3.85 | 4.00 | 4.85 | 5.35 |
| ⅝ and ¾ | 3.50@3.75 | 4.26 | 3.61 | 4.00 | 4.15 | 5.00 | 5.50 |
| ⅞ and 1 | 3.75@4.00 | 4.50 | 3.85 | 4.25 | 4.40 | 5.25 | 5.75 |

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in take an extra of 25c.

**NAILS**—The following quotations are per keg from warehouse:

| | Pittsburgh Mill | Chicago | San Francisco | Dallas | St. Louis | Montreal |
|---|---|---|---|---|---|---|
| Wire | $2.80@3.00 | $3.45 | $4.20 | $4.25 | $3.19 | $4.95 |
| Cut | 3.25 | 5.50 | 5.80 | 5.75 | 3.24 | 5.00 |

**PREPARED ROOFINGS**—Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $2.50 per roll in less than carload lots f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.75 per square (sufficient to cover 100 sq.ft.) in less than carload lots, f.o.b. Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $6.20.

**ROOFING MATERIALS**—Prices f.o.b. New York, in less than carload lots:

| | |
|---|---|
| Tar felt (14 lb. per square of 100 sq.ft.) per ton | $67.50 |
| Tar pitch (in 400-lb. bbl.), per 100 lb | 1.62½ |
| Asphalt roofing (in barrels), per ton, f.o.b. plant* | 38.75 |
| Asphalt felt (light), per ton, f.o.b. plant* | 75.00 |
| Asphalt felt (heavy), per ton, f.o.b. plant* | 75.00 |

* Delivered in Metropolitan Dist., $3.00 additional.

**WINDOW GLASS**—Double strength, box list, united inches, 34, "AA", "A" and "B" grades, all at discount of 84 per cent from standard lists, f.o.b. New York.

**SHEETS**—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

| Blue Annealed | Pittsburgh Large Mill Lots | St. Louis | Chicago | San Francisco | New York |
|---|---|---|---|---|---|
| No. 10 | $2.65@3.25 | $4.25 | $4.15 | $4.60 | $4.34 |
| No. 12 | 2.75@3.35 | 4.30 | 4.20 | 4.65 | 4.39 |
| No. 14 | 2.85@3.45 | 4.35 | 4.25 | 4.70 | 4.44 |
| No. 16 | 3.05@3.65 | 4.45 | 4.35 | 4.75 | 4.54 |
| Black | | | | | |
| *Nos. 18 and 20 | 3.35@3.60 | 4.80 | 4.85 | 5.70 | 4.70 |
| *Nos. 22 and 24 | 3.40@3.65 | 4.85 | 4.85 | 5.75 | 4.75 |
| *No. 26 | 3.45@3.70 | 4.90 | 4.90 | 5.80 | 4.80 |
| *No. 28 | 3.50@3.75 | 5.00 | 5.00 | 5.90 | 4.90 |
| Galvanized | | | | | |
| No. 10 | 4.00@4.25 | 5.00 | 4.85 | 5.75 | 4.90 |
| No. 12 | 4.10@4.35 | 5.10 | 4.95 | 5.85 | 5.00 |
| No. 14 | 4.10@4.35 | 5.10 | 4.95 | 5.85 | 5.00 |
| Nos. 17 to 21 | 4.40@4.65 | 5.25 | | 6.15 | 5.30 |
| Nos. 22 and 24 | 4.55@4.80 | 5.55 | 5.40 | 6.30 | 5.45 |
| *Nos. 25 and 26 | 4.70@4.95 | 5.70 | 5.55 | 6.45 | 5.60 |
| *No. 28 | 5.00@5.25 | 6.00 | 5.85 | 6.75 | 5.90 |

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

**LINSEED OIL**—These prices are per gallon:

| | New York Apr. 5 | New York One Year Ago | Chicago Apr. 5 | Chicago One Year Ago |
|---|---|---|---|---|
| Raw in barrels (5 bbl. lots) | $1.13 | $0.82@0.83 | $1.15 | $0.90 |

**WHITE AND RED LEAD**—Base price in cents per pound:

| | Red | | | | White | |
|---|---|---|---|---|---|---|
| | Apr. 5 | | 1 Year Ago | | Apr. 5 Dry or In Oil | Yr. Ago Dry or In Oil |
| | Dry | In Oil | Dry | In Oil | | |
| 100-lb. keg | 14.25 | 15.75 | 12.25 | 13.75 | 14.25 | 12.25 |
| 25 and 50-lb. kegs | 14.50 | 16.00 | 12.50 | 14.00 | 14.50 | 12.50 |
| 12½-lb. keg | 14.75 | 16.25 | 12.75 | 14.25 | 14.75 | 12.75 |
| 5-lb. cans | 17.25 | 18.75 | 15.25 | 16.75 | 17.25 | 15.25 |
| 1-lb. cans | 19.25 | 20.75 | 17.25 | 18.75 | 19.25 | 17.25 |

# LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

**San Francisco**—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To contractors, $2 per M ft. additional.

| | 6–8 and 12 Ft. | 10–16–18 and 20 Ft. | 22 and 24 Ft. | 25 to 32 Ft. |
|---|---|---|---|---|
| 3x3 and 4 | $38.00 | $39.00 | $40.00 | $43.00 |
| 3x6 and 8 | 38.00 | 39.00 | 40.00 | 43.00 |
| 4x4-6 and 8 | 38.00 | 39.00 | 40.00 | 43.00 |
| 3x10 and 12 | 38.00 | 39.00 | 40.00 | 43.00 |
| 3x14 | 40.00 | 40.00 | 42.00 | 44.00 |
| 4x10 and 12 | 38.00 | 39.00 | 40.00 | 43.00 |
| 4x14 | 40.00 | 40.00 | 42.00 | 44.00 |

| | 24 Ft. and Under | 25 to 32 Ft. | 33 to 40 Ft. |
|---|---|---|---|
| 6x10 | $40.00 | $42.00 | $44.00 |
| 6x14 | 40.00 | 42.00 | 44.00 |
| 8x10 | 40.00 | 42.00 | 44.00 |
| 8x14 | 40.00 | 42.00 | 44.00 |

**New York and Chicago**—Wholesale prices to dealers of long leaf yellow pine.

| | New York* | | Chicago | |
|---|---|---|---|---|
| | 20 Ft. and Under | 22–24 Ft. | 20 Ft. and Under | 22–24 Ft. |
| 3x 4 to 8x8 | $50.00 | $51.00 | $54.50 | $56.50 |
| 3x10 to 10x10 | 54.00 | 55.00 | 57.50 | 59.50 |
| 3x12 to 12x12 | 58.00 | 59.00 | 60.50 | 62.50 |
| 3x14 to 14x14 | 65.00 | 66.00 | 65.50 | 67.50 |
| 3x16 to 16x16 | 70.00 | 71.00 | 70.50 | 72.50 |
| 3x18 to 18x18 | 84.00 | 85.00 | 82.50 | 83.50 |
| 4x20 to 20x20 | 94.00 | 95.00 | 93.50 | 95.50 |

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under.

**Other Cities**

| | 8 x 8-In. x 20 Ft. and Under | | | 12 x 12-In. 20 Ft. and Under | |
|---|---|---|---|---|---|
| | P. | Fir | Hemlock | Spruce | P. | Fir |
| Boston | $67.00 | $125.00 | $65.00 | $65.00 | $90.00 | $140.00 |
| Seattle | | 30.00 | | | | 30.00 |
| New Orleans | 40.00 | 35.00 | | 35.00 | 40.00 | |
| Baltimore | 35.00 | 53.00 | 53.00 | 60.00 | 50.00 | 53.00 |
| Cincinnati | 45.00 | 51.50 | 51.50 | 51.50 | 45.00 | 53.50 |
| Montreal | 50.00 | | | | 95.00 | 90.00 |
| Los Angeles | | | | | | |
| Denver | | 40.75 | 39.75 | | | 42.75 |
| Minneapolis | 46.50 | 44.75 | 41.50 | | 49.00 | 45.75 |
| Atlanta | 36.00 | | | | 40.00 | |
| Dallas | 48.00 | | | | 53.00 | |
| Kansas City | 45.75 | 44.75 | 44.75 | | 58.75 | 48.75 |
| Birmingham | 35.00 | | | | 43.00 | |
| Philadelphia | 47.00 | 41.50 | 40.00 | 45.00 | 58.00 | 42.00 |
| Detroit | 49.75 | 50.25 | | | 58.25 | 50.25 |
| St. Louis | 44.00 | | | | 51.00 | |

| | 1-In. Rough, 10 In. x 16 Ft.— and Under | | | 2-In. T. and Gr. 10 In. x 16 Ft. | |
|---|---|---|---|---|---|
| | P. | Fir | Hemlock | P. | Fir |
| Boston | $50.00 | $85.00 | $50.00 | $60.00 | $100.00 |
| Seattle | | 25.00 | | | 28.50 |
| New Orleans, at mill | 80.00 | | | 39.00 | |
| Baltimore | 65.00 | 44.00 | 44.00 | 37.00 | 55.00 |
| Cincinnati | 60.00 | 82.00 | 82.00 | 35.00 | 78.00 |
| Montreal | | 50.00 | 37.00 | 45.00 | 45.00 |
| Los Angeles | | 48.00 | | | |
| Denver | | 37.25 | 36.25 | | 37.75 |
| Minneapolis | 48.50 | 43.25 | 39.50 | 43.75 | 41.25 |
| Atlanta | 20.00 | | | 30.00 | |
| Dallas | 48.00 | | | 51.50 | |
| Kansas City | 81.00 | | | 69.00 | |
| Birmingham | 32.00 | | | 40.00 | |
| Philadelphia | 37.00 | 43.00 | 40.00 | 57.00 | 41.50 |
| Detroit | 48.75 | 42.00 | | 47.00 | 42.50 |
| St. Louis | 45.50 | | | 35.50 | |

Birmingham—Quotes carload lots, f.o.b. sidings. $1.50 additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, f.o.b. cars, $3 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

# FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

| | | | |
|---|---|---|---|
| Baltimore | $0.315 | Detroit | $0.295 |
| Birmingham | .69 | Kansas City | .735 |
| Boston | .365 | New Orleans | .515 |
| Buffalo | .265 | New York | .34 |
| Chicago | .34 | Pacific Coast (all rail) | 1.50† |
| Cincinnati | .295 | Philadelphia | .325 |
| Cleveland | .215 | St. Louis | .43 |
| Denver | 1.275* | St. Paul | .595 |

* Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

# CONTRACTORS' SUPPLIES

**STEEL SHEETPILING**—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

| Apr. 5 | One Month Ago | One Year Ago |
|---|---|---|
| $2.30@2.70 | $2.15@2.30 | $1.75 |

**WIRE ROPE**—Discounts from list price on regular grades of bright and galvanized are as follows:

| | Eastern Territory New York and East of Missouri River |
|---|---|
| Hercules red strand, all constructions | 25% |
| Patent flattened strand, special and cast steel | 25% |
| Patent flattened strand, iron rope | 10% |
| Plow steel round strand rope | 40% |
| Special steel round strand rope | 35% |
| Cast steel round strand rope | 27½% |
| Round strand iron and iron tiller | 10% |
| Galvanized steel rigging and guy rope | 12½% |
| Galvanized iron rigging and guy rope | +7½% |

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

**MANILA ROPE**—For rope smaller than ¼-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ⅛-in., 8 ft., ¼-in., 6; ⅜-in., 4½; ½-in., 3½; ⅝-in., 2 ft. 10 in.; ¾-in., 2 ft. 4 in. Following is price per pound for ¼-in. and larger, in 1200-ft. coils:

| | | | |
|---|---|---|---|
| Boston | $0.16½ | New Orleans | $0.18½ |
| New York | .18 | Los Angeles | .... |
| Chicago | .18 | Seattle | .18 |
| Minneapolis | .20½ | St. Louis | .19½ |
| San Francisco | .18 | Montreal | .30 |
| Atlanta | .21 | Detroit | .19 |
| Denver | .22 | Baltimore | .18 |
| Cincinnati | .20 | Kansas City | .20½ |
| Dallas | .129 | Birmingham | .20½ |
| Philadelphia | .18 | | |

**EXPLOSIVES**—Price per pound of dynamite in small lots:

| | Gelatin 40% | Gelatin 60% |
|---|---|---|
| New York | $0.27 | $0.30 |
| Boston | .23 | .25 |
| Kansas City | .2225 | .2525 |
| Seattle | .165 | .195 |
| Chicago | .22 | .25 |
| Minneapolis | .189 | .2094 |
| St. Louis | .2225 | .2525 |
| Denver | .2025 | .2325 |
| Dallas | .29 | .375 |
| Los Angeles | .... | .... |
| Atlanta | .23 | .26 |
| Baltimore | .215 | .225 |
| Cincinnati | .22 | .25 |
| Montreal | .195 | .235 |
| Birmingham, *delivered* | .16 | .17 |
| New Orleans | .235 | .265 |
| San Francisco | .1625 | .1925 |
| Philadelphia | .2625 | .296 |

**PILES**—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

| Diameters | Points | Length | Barge | Rail |
|---|---|---|---|---|
| 12 in. at butt | 6 in. | 30 to 50 ft. | $0.13 | $0.17½ |
| 12 in.—2 ft. from butt | 6 in. | 50 to 59 ft. | 0.17½ | 0.22 |
| 12 in.—2 ft. from butt | 6 in. | 60 to 69 ft. | 0.19½ | 0.24 |
| 14 in.—2 ft. from butt | 6 in. | 50 to 69 ft. | 0.23 | 0.32 |
| 14 in.—2 ft. from butt | 6 in. | 70 to 79 ft. | 0.25 | 0.34 |
| 14 in.—2 ft. from butt | 5 in. | 80 to 89 ft. | 0.32 | 0.38 |

**SCRAP**—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

| | New York | Chicago | St. Louis |
|---|---|---|---|
| No. 1 railroad wrought | $21.00 | $11.50 | $17.00 |
| Stove plate | 17.00 | 12.00 | 17.50 |
| No. 1 machinery cast | 21.00 | 16.50 | 21.00 |
| Machine shop turnings | 14.00 | 4.00 | 12.00 |
| Cast borings | 15.00 | 5.50 | 12.00 |
| Railroad malleable cast | 20.00 | 12.50 | 19.50 |
| Re-rolling rails | 21.00 | 13.00 | 21.00 |
| Relaying rails | 28.50 | 30.00 | 29@33 |
| Heavy melting steel | 19.00 | .... | .... |

**SHIP SPIKES**—Current prices per 100 lb.:

| In. | San Francisco Galv. | San Francisco Black | Seattle Black |
|---|---|---|---|
| ½ | $8.25 | $6.25 | $8.00 |
| ⅝ | 7.30 | 5.80 | 7.75 |
| ¾ | 7.15 | 5.65 | 7.70 |

Pittsburgh base in lots of 200 kegs or more, $3.50.